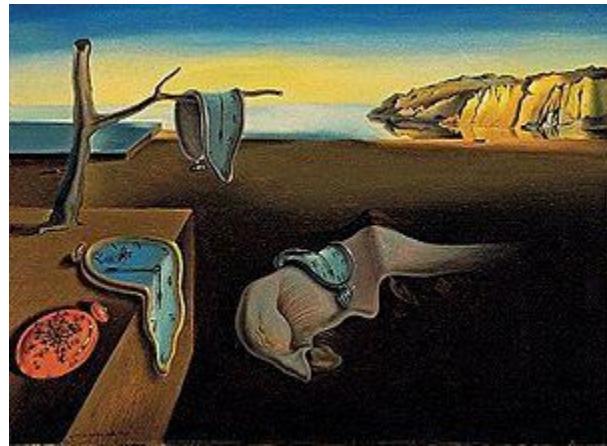


# The extended present



The Persistence of Memory, 1931, Salvador Dali

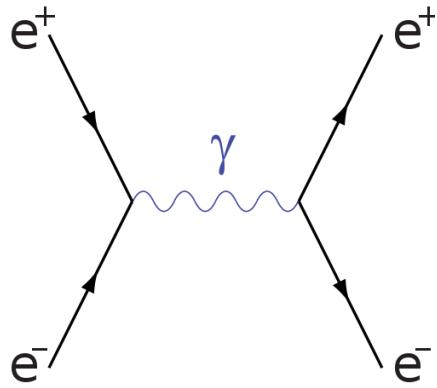
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## The deceit of natural phenomena

Events that happen around us are effects. We seek their cause after they take place. The process of causation is retrospective and illusory: It goes backwards in time from the effect to the cause using logical inference. But the word ‘phenomenon’ means ‘what seems to be,’ so in order to give events form, shape and meaning, we imagine ‘what they really are.’ Perception of events happens, more or less, instantaneously and unconsciously. Then events are processed by logical deduction. Consequently our reasoning falls into the fallacy of infinite regress: each cause is the effect of a previous cause, and so on. This is definitely a case of backward causation. Our vision also works this way: we realize the true position of an object by regarding an imaginary path backwards from the eyes towards physical space. Some theories combine forward and backward processes, with respect to vision. More generally, combinations of backward and ‘forward’ causation give rise to a notion of symmetry. Wheeler-Feynman absorber theory is an example from physics. However, theories of symmetry bring forward the paradox of a journey in time. Quantum- mechanics introduces the notions of causality and symmetry with a new perspective, as the problem of non-locality and simultaneity demands an answer. This answer, however, may introduce new and more puzzling paradoxes, questioning anew the nature of space-time itself. Here the notion of the extended present comes into play. According to this notion, the present is not a point-like event but it covers an area, while the future and the past are ‘distant’ events found inside this area. However, all the events that take place within the extended present are conditional and simultaneous, at an initial stage, only to be causally related and interpreted at a second level. Furthermore, consciousness, as a natural phenomenon itself, exhibits the same extended character, with respect to the way it attributes space and time to the events. Consequently the linear way of causal thinking is replaced by a ‘causal loop’ of ‘spontaneous ingenuity’ and of ‘holistic perspective,’ where time- space and its events acquire a different meaning and a new outlook.

## Backward causation and vision



Electron ( $e^-$ )- positron ( $e^+$ ) annihilation process depicted with a Feynman diagram. A photon ( $\gamma$ ) is produced, to give its place anew to an electron- positron pair.

According to Stanford encyclopedia of philosophy, the principle underlying ‘backward causation,’ which is sometimes also called retro-causation, is quite simple: Let A and B be two events in the sense that A causes B to happen. If we have no direct knowledge of A, then we must deduce it by going backwards from B to A. This is the road of backward causation. The procedure neither implies the creation of A by B, nor a journey back in time. It helps us instead reconstruct the whole process in an abstract manner.

Backward causation is related with the following paradox: Let’s suppose a causal chain consisting of particular events in which A causes B, B causes C, and C causes A. The problem here is that the occurrence of A presupposes the occurrence of C; in other words, the cause presupposes its effect. But how can something be required of what itself requires? However, the answer is very simple: the event caused by C is not the original event A but a new event because it happens at a different place and/or at a different time with respect to A. Furthermore, as far as causal loops are concerned, they don’t consist of ‘causal chains’ of events. They are unique events themselves. In fact, the events A, B and C in the previous example can be causal loops connected to each other causally or not. But if these three events are included in the same causal loop then they occur simultaneously otherwise they are retrospectively regarded. This is the key point.

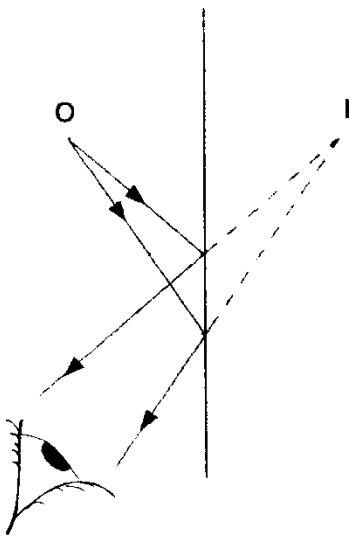


Figure 1. A typical textbook diagram showing how reflection in a plane mirror produces a virtual image (I) of the object (O). The dotted lines indicate virtual rays. (After Duncan and Kennett, 2001).

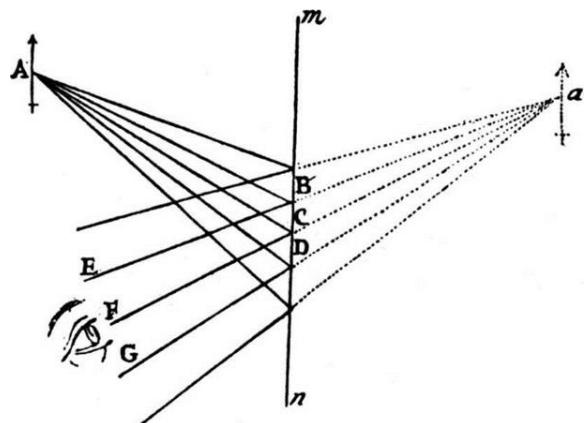


Figure 2. Isaac Newton's diagram of reflection in a plane mirror; "If an Object A be seen by Reflexion of a Looking-glass mn, it shall appear, not in its proper place A, but behind the Glass at a." (Newton, 1730, Figure 9).

We will return to causal loops later on. For the moment, a good example of backward causation which takes place in a natural way is vision. The problem of vision is divided into two basic categories: Emission or extra-mission, and intromission theories. Extra-mission theories regard vision as an active process, where rays are supposed to be emitted from the eyes towards the objects. The previous images as well as the following historical flashback is from Rupert Sheldrake's article 'The Sense of Being Stared At:' Plato adopted the idea of an outward-moving current, but he also proposed that it was combined with light to form a 'single homogeneous body' stretching from the eye to the visible object. This extended medium was the instrument of visual power reaching out from the eye. Through it, influences from the visible object passed to the soul. Aristotle followed Plato in emphasizing the importance of an intermediate medium between the eye and the seen object, which he called 'the transparent.' He thought of light not as a material substance, but as a 'state of the transparent,' resulting from the presence of a luminous body. The visible object was the source or the cause of change in the transparent, through which influences were transmitted instantaneously to the soul of the observer.

Another early advocate of an extra-mission theory was Euclid. His approach was strictly mathematical and excluded practically all aspects of vision that could not be reduced to geometry. He assumed that light rays travelled in straight lines and he worked out geometrically how eyes projected the images we see outside ourselves. He explained virtual images in terms of the movement of visual rays outwards from the eyes. He also clearly stated the principles of mirror reflection, recognizing the equality of what we now call the angles of incidence and reflection.

Intromission theories, on the other hand, treated vision as a passive process that was accomplished through light rays from bright objects. Democritus, propounding the doctrine that ultimate reality consists of particles of matter in motion, proposed that material particles streamed off the surface of things in all directions, so that vision depended on these particles entering the eye. In order to account for coherent images, he supposed that the particles were joined together in thin films that travelled into the eye. Other mathematicians, most notably Claudius Ptolemy, took Euclid's geometrical approach further. He also proposed that the visual flux coming out of the eyes consisted of ether, or quintessence, or fifth element.

We can see that both theories were based on causation, either forward or backward. In order to explain vision, forward causation assumed that the eyes produced light rays, whereas backward causation supposed the existence of imaginary paths connecting the brain to the external object. After the Middle- Ages, technological advances made it clear that the intromission theory was basically correct, even if there might be some underlying unconscious processes. Kepler's theory of retinal images was published in 1604. Newton in his 'Opticks,' first published in 1704, used the same kind of theory. His very reasonable explanation about vision was that the reflected rays incident on the spectator's eyes "make the same picture in the bottom of the eyes as if they had come from the real object without the interposition of the looking-glass; and all vision is made according to the place and shape of that picture." In fact Newton's theory of virtual images was first codified in Euclid's 'Catoptrics,' and his diagrams showing the location of virtual images behind plane mirrors are essentially identical to those in modern textbooks. The main difference is the reversal of the whole process and the paradigm shift from forward to backward causation.

## Perception and unconscious inference

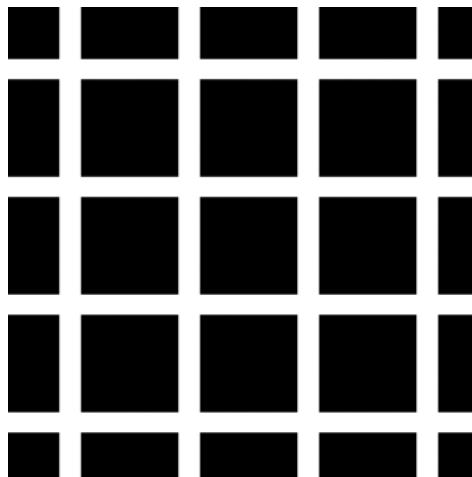
Since the 1980s the predominant academic approach has been to suppose that vision depends on computational processing and on the formation of representations inside the brain. David Marr summarized this position as follows: “Vision is the process of discovering from images what is present in the world, and where it is. Vision is therefore, first and foremost, an information-processing task, but we cannot think of it as just a process. For if we are capable of knowing what is where in the world, our brains must somehow be capable of representing this information in all its profusion of color and form, beauty, motion and detail.”

Is this model, however, sufficient to include all aspects of vision? How come, for example, on the basis of the fragmented and discontinuous information we receive from the outside world, that we are able to enjoy the impression of seamless consciousness of an environment detailed and continuous? In fact what we see from the previous discussion is that, in order to explain vision, both theories, either extra-mission or intromission, suppose the existence of some sort of ‘visual’ or ‘virtual’ rays that connect the object to the eyes of the observer, regardless of the cause. So we may say that vision belongs to phenomenology. The geometry of the whole phenomenon seems to be of secondary importance since what matters is the final ‘*virtual image*’ of the real object imprinted on the retina and reconstructed by the brain.

According to Wikipedia, Hermann von Helmholtz, who is often credited with the first study of visual perception in modern times, examined the human eye and concluded that it was optically rather poor. The poor-quality information gathered via the eye seemed to him to make vision impossible. He therefore concluded that vision could only be the result of some form of unconscious inferences: a matter of making assumptions and conclusions from incomplete data, based on previous experiences.

Inference requires prior experience of the world. Our brain is based on a background of pre-assumptions concerning the properties of events which we have either experienced or learned about. In other words, we are always ‘prejudiced’ against things and beings; we impose our determinism about what they are or what they ‘should’ be. Moreover, this process takes place instantaneously and unconsciously. If we have to face a new event or to find the missing parts of

a half- understood object, the unconscious tends to reassemble the object by comparison, in an automated way.



The ‘Hermann grid illusion:’ an optical illusion characterized by virtual grey blobs perceived to appear at the intersections of the white lines with the black squares. The blobs disappear when looking directly at an intersection.

The previous image depicts in a graphical way the phenomenon of unconscious inference. The underlying theory stems from gelstat psychology. According to Wikipedia, the word ‘gelstat’ in German means: “essence or shape of an entity’s complete form.” Gestalt psychology assumes that the brain is holistic, parallel and analog, with self- organizing tendencies. Thus we tend to see objects in their entirety before perceiving their individual parts. The so- called gestalt effect is the form- generating capability of our senses, particularly with respect to the visual recognition of figures and whole forms instead of just a collection of simple lines and curves. The phrase “the whole is greater than the sum of the parts” is often used when summarizing gestalt theory.

Gestalt theory allows for the breakup of elements from the whole situation into what they really are. In the same way consciousness analyzes complete forms and shapes into their parts in order to recognize details and find mistakes made at the initial stage of unconscious inference. The brain imprints a ‘virtual reality’ in memory using in- built logical channels which consist of predetermined structures and are based on previous memories.

So, does a virtual object inside the brain coincide with the physical one in the ‘outside’ world? Well, we know, for example, that the child sitting next to us is our son; that the distant mountains

we see are those we visited last year; that the faint star we watch in the night sky is the one we found on a map of astronomy; that our reflection in the mirror is us, not anyone else; and so on. From time to time estimations may be wrong, but generally we have a consistent idea about reality. The light reflected by objects makes them visible, while our eyes are the physical receptors and our brain is the logical processor. If the senses and the brain were different, we wouldn't be irrational or unnatural; just the deductions would be different.

## Logic and infinite regress



Scene from the film 'Planet of the apes;' the narrator explains how the painter infinitely regresses in order to realize the totality of his painting, including himself in it.

Our brain uses imaginary paths in order to trace the real position of objects. It also uses backward causation to find the causes of things. In fact all phenomena are effects of preceding causes which are often invisible or incomprehensible. Let's take light for example: It is itself invisible but we regard its existence and consider it a cause in order to explain why things are visible. We don't see 'photons' but we suppose that light consists of them. We also say that light is produced by accelerating charged particles (electrons), so light is in turn an effect that has a preceding cause. Is now an electron fundamental? It is not according to string theory. Even the properties of matter, such as charge or mass, were not fundamental at the beginning of the universe. And we might furthermore ask what existed before. Was there another universe? And even before, was there another, and another, and so on? This is how an infinite regress begins. It is regress because causation goes backwards, and it is infinite because there isn't any starting or ending point.

We may present this procedure of backward causation with a series of events  $P_n$  as follows:

$$P_0 = P_1 - I,$$

$$P_1 = P_2 - I,$$

$$P_2 = P_3 - I,$$

...

and generally

$$P_n = P_{n+1} - I,$$

where  $I$  is a ‘logical step’ taking us back from one event to another. In our example, if  $P_0$  stands for an event at present time then  $P_n$  is the primary cause, even if there will always be a step before. This procedure constitutes an infinite causal chain of events, where each previous event is the cause of the following one. An infinite causal chain has no limits. We may use any means of logical deduction but we can never reach an end or a ‘primal’ cause.

Infinite causal chains are logically valid but nevertheless inconsistent, or, let’s say, incomplete, with regard to common experience. If for example we want to know if an argument is true or not, we may be lost in an infinite- step logical deduction without getting back to a primary cause. However, this never ending situation of analytical reasoning is inconsistent with common experience because we all know that primary causes exist as self- evident ‘truths.’ This fundamental and paradoxical aspect of reasoning was mathematically expressed by Gödel in his incompleteness theorem. This theorem states that in any logical system there are truths that cannot be proved by its premises. So Gödel’s theorem has given an end to the belief or ambition that there should be some kind of ‘perfect’ logic. We do not demonstrate truths, we accept them.

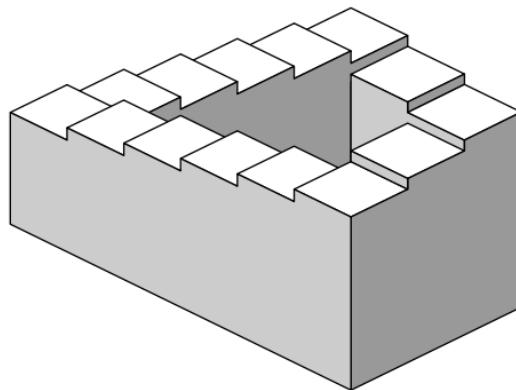
The same sort of contradiction occurs with respect to the notion of time. The series of events previously described form an infinite causal chain also in time: the cause happens ‘before,’ while the effect takes place ‘after.’ So while the future becomes unpredictable by postulate, the past remains undefinable by definition, because there’s no end or beginning, respectively. But if there isn’t any initial point then time assumes a different and ‘circular’ meaning. This is the case of an infinite causal loop. It is infinite because each of its points is at the same time an ‘end’ and a ‘beginning.’ For the same reason, an infinite loop is *acausal*, despite the fact that it is used to be called causal, as it seems to be created

‘spontaneously.’ So there isn’t any initial cause. Such a loop consists of events which can either be sets of infinite causal chains or other infinite causal loops, while the loop is an event on its own. Infinite loops seem to be both the cause and the effect of themselves, in the same sense that all their points are causally two-fold.

Nevertheless, we are faced with a problem here: If an infinite causal loop can be justified as a cause of itself, then logical deduction loses any meaning: How can we move from a point to another when there is neither a motivating cause nor a resulting effect? It looks like a self- fulfilling prophecy, where a future event seems to prepare the *past* conditions that will establish it. However, if we regard an event not as a point-like incident in space-time but as an extended object occupying space-time instead, then this event acquires a ‘past’ and a ‘future’ itself. This is the meaning of the extended present: It is not a point-like event that takes place ‘here and now,’ but it covers some area so that it can expand backwards and forward in space and time. It has the properties of an infinite causal loop, which spontaneously generates events ‘temporally neutral,’ only to be ‘causally charged’ later on by subjective and man- made, spatial and temporal, characteristics.

### **Self- reference and impossible objects**

The notion of an infinite causal loop is portrayed in a vivid way by Douglas Hofstadter in his book ‘I am a strange loop:’ “And yet when I say ‘strange loop,’ I have something else in mind- a less concrete, more elusive notion. What I mean by ‘strange loop’ is- here goes a first stab, anyway- not a physical circuit but an abstract loop in which, in the series of stages that constitute the cycling-around, there is a shift from one level of abstraction (or structure) to another, which feels like an upwards movement in a hierarchy, and yet somehow the successive ‘upward’ shifts turn out to give rise to a closed cycle. That is, despite one’s sense of departing ever further from one’s origin, one winds up, to one’s shock, exactly where one had started out. In short, a strange loop is a paradoxical level-crossing feedback loop.”



The Penrose stairs is a two-dimensional depiction of a staircase in which the stairs make four 90° turns as they ascend or descend; yet form a continuous loop so that a person could climb them forever and never get any higher.

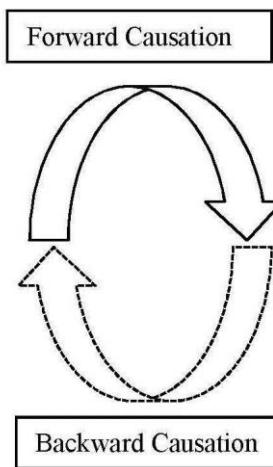
As Wikipedia says, a strange loop is technically called tangled hierarchy consciousness and arises when, by moving only upwards or downwards through a hierarchical system, one finds oneself back where one started. Strange loops may involve self-reference and paradox. The paradox arises when what we perceive comes into conflict with common sense. The staircase, for example, in the previous figure depicts the endless journey of someone ascending and descending forever.

Impossible objects are physiologically formed when holistic unconscious inference is faced with analytical conscious reasoning. Usually there is a trick, a sort of optical illusion, so that the brain gets confused trying to reconstruct the impossible object. In the previous figure, a step should be lower than the others, despite the fact that we cannot discern which one is. Optical illusions may be compared to logical absurdity. In fact impossible objects are products of conception rather than perception. They are not produced by a conflict between the brain and the eyes, but between the conscious and the unconscious. So the main problem is one of consciousness.

This logically contradictory character of impossible objects may be explained by the fact that they are causally unrelated. They cannot be compared to any other ‘common’ object because they don’t fit the general presupposition to be parts of the whole. They form totalities themselves. So, in some sense, they exist even if they are deductively impossible. Infinite causal loops are such ‘impossible’ objects. They seem strange because they possess the property of spontaneous generation. The impression that they progressively evolve to higher levels of hierarchy, may be

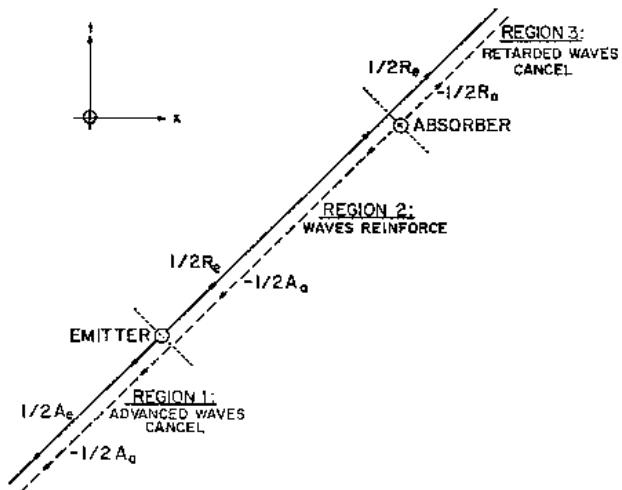
wrong. An ‘upward’ (or ‘downward’) kind of ‘movement’ could be illusionary as impossible objects suggest anyway. More likely it would be some sort of a ‘trend,’ causally expressed as a respective motion in space-time. Infinite causal loops are in fact ‘strange’ and impossible objects, since they are generated spontaneously and evolve progressively. But this progress is always related to specific hierarchical attributions set by consciousness, and, moreover, retrospectively. For example, space-time as we know it is not yet triggered at the initial stage of the loop formation. On the other hand, space-time has to expand *together* with the loop’s expansion.

This is a basic characteristic also of the extended present. A temporal aspect is given to the events at the second stage of causal interrelation. Before, all the events had existed in a condition of simultaneity until consciousness was triggered and dealt with them. So consciousness is itself an extended impossible object since it stretches out in space and time to infinity. And even if it causally relates events to each other, with respect to a special event at present, at some following stage, it has already performed a strange loop at the previous stage of unconscious inference. This fact explains common intuitions and sentiments, like the sense of ‘déjà vu.’ These cases of ‘heterochronism’ or of causality violations reflect on a prototype state of events. More specifically, they represent an initial and instantaneous expansion of the events in the extended present, before any hierarchical progress of consciousness takes place.



A symmetric infinite causal loop consisting of forward and backward causation

We may think of infinite causal loops as two-fold objects. One half consists of ‘forward’ causation, while the other half is formed by ‘backward’ causation. If, for example, we represent the process of vision with such a loop, we may regard a bilateral process of extra-mission and intromission. So, on one hand we might assume some sort of ‘substance’ coming out of the eyes or the mind, making objects visible. On the other hand, if vision is made possible by light rays entering the eyes, we might conclude that the brain reconstructs images only passively and indirectly. However, one way or the other, we are faced with paradox: Forward causation brings about determinism, according to which our mind might be powerful enough to create its own reality. Backward causation instead adopts a probabilistic aspect of the world, which in turn might lead to the speculation of an illusory world. So we more likely tend to search for the ‘golden mean’ that finally reconciles the two extremes.



Minkowski diagram of type I emitter-absorber transaction. The emitter produces a retarded half-amplitude wave  $R_e$  and an advanced half-amplitude wave  $A_e$ . The absorber produces a half-amplitude retarded wave  $R_a$  which cancels  $R_e$  in region 3. It also produces a half-amplitude advanced wave  $A_a$  which reinforces  $R_e$  in region 2 and cancels  $A_e$  in region 1. An observer sees only a full-amplitude retarded wave ( $R_e + A_a$ ) in region 2 passing from emitter to absorber. (Dashed lines indicate a  $180^\circ$  phase shift.)

Such an example of reconciliation at the level of quantum-mechanics is Wheeler-Feynman absorber theory. According to Stanford encyclopedia of philosophy, it is an approach to electrodynamics introduced in 1945 by physicists Archibald Wheeler and Richard Feynman, which proposes a time-symmetric boundary condition asserting that a proper electromagnetic wave

is composed of a half-amplitude ‘retarded’ wave and a half-amplitude ‘advanced’ wave, and that such waves are characteristic of both emission and absorption processes.

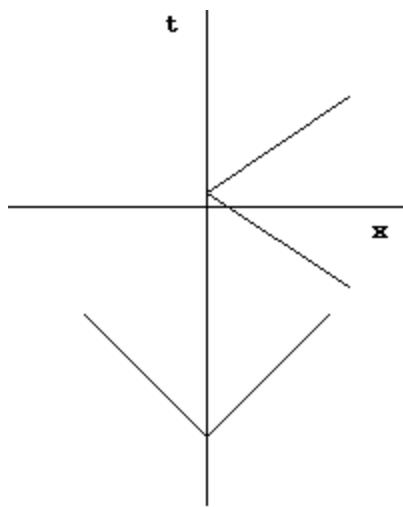
The previous figure, where an emitter- absorber event is illustrated, is from the site of John G. Cramer. According to his description, the absorber can be considered to perform the absorption by producing a canceling retarded wave which is exactly  $180^\circ$  out of phase with an incident radiation, so that the incident wave ‘stops’ at the absorber. But the Wheeler-Feynman time-symmetric boundary condition tells us that the production of this canceling wave will be accompanied by the production of an advanced wave, which will carry negative energy in the reverse time direction and travel back, both in space and in time, to the point and the instant of emission. This advanced wave may be reinterpreted as a retarded wave traveling in the opposite direction and will reinforce the initial retarded wave, raising it from half to full amplitude. When the new advanced wave ‘passes’ the point of emission, it will be superimposed on the initial half-amplitude advanced wave and, because of the  $180^\circ$  phase difference imposed by the absorber, it will cancel this wave completely. Thus, an observer viewing this process will perceive no advanced radiation, but will describe the event as the emission of a full-amplitude retarded wave by the emitter, followed by the absorption of this retarded wave by the absorber at some later time.

The symmetrical aspect of Wheeler-Feynman absorber theory is straightforward. As Stanford encyclopedia of philosophy says, the theory was put forward to explain the energy loss (damping) of an oscillating (i.e. accelerating) particle radiating some form of energy. In order to explain the damping, the theory uses the notion of advanced waves, instead of a self-interaction of the radiating particle with its own field. However, this interpretation raises the question of causality because advanced waves seem to travel back in time.

Could this, with respect to the way we visualize the world, be interpreted as an ‘act of prophesy?’ Could advanced waves explain the virtual images formed in the brain while the process of vision takes place? The truth is, however, that we don’t produce vision, neither do objects. Instead, both we and the objects interact with the medium, which, in this case, is light. Furthermore, awareness seems to presuppose a spontaneous loop of a pair of events. Such a pair is for example the observer and what is observed. Space-time itself seems to be essentially symmetric. Self- reference in turn

is a symmetric infinite loop that simultaneously produces an ‘advanced’ and a ‘retarded’ part of a pair of events. Impossible objects also reveal an extension of things that cannot be perceived as a linear series of events taking place one after another. Similarly, if we separate the future from the past, a journey in time is impossible. But if we regard the present as an extended object that stretches out both into the future and into the past, then the future and the past are just consequential aspects of the extended present.

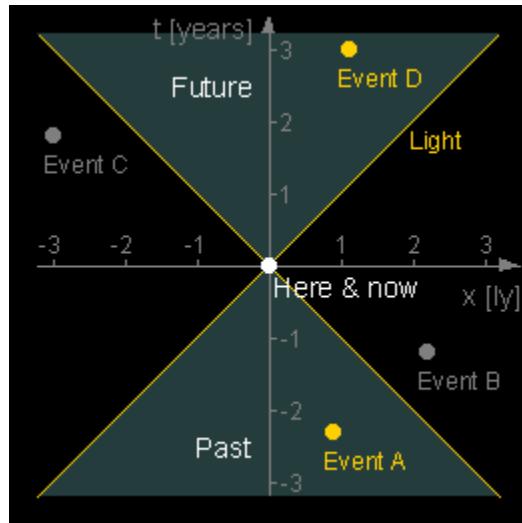
### The paradox of a ‘journey in time’



The lower light cone is characteristic of light cones in flat space; all space-time coordinates included in the light cone have later times. The upper light cone not only includes other spatial locations at the same time, but it also includes earlier times.

Stanford encyclopedia of philosophy says that the idea of backward causation doesn’t necessarily imply time travel. This might be obvious because when we use backward causation we do it in the present and this process of thought has nothing to do with time travel. It is also supposed that these two notions are related to the extent that both agree that it is possible to causally affect the past. However, time travel involves a causal loop whereas backward causation does not. In fact, as we have previously seen, backward causation is ‘one half’ of a causal loop, the ‘other half’ being forward causation. Causal loops for their part can only occur in a universe in which one has closed time-like curves. In contrast, backward causation may take place in a world where there are no such closed time-like curves. So neither backward causation nor time travel logically entail each other and time travel is distinct from back-in-time travel.

On the other hand, the notion of the extended present does not render time travel impossible. Instead it gives space and time a different meaning. The extended present, as an infinite causal loop, has the properties of a closed time-like curve. Such a curve is a ‘world-line,’ in space-time, that is ‘circular,’ so that a traveler could return to the point where he started, both in space and time. This means that somebody travelling on a closed time-like curve could return to his own past. This possibility was first raised by Kurt Gödel. According to Wikipedia, he discovered in 1949 closed time-like curves as a solution to the equations of Einstein’s general relativity and since then other similar solutions have been found. Closed time-like curves could occur near strong gravitational fields or could be caused by great accelerations.

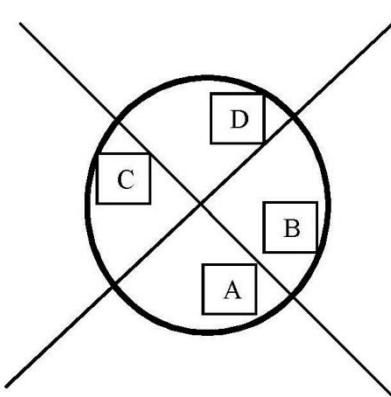


A light-cone

More generally, we can represent events that take place in space-time with the above Minkowski diagram. A light-cone is the path that a flash of light, emanating from a single event and traveling in all directions, would take through space-time. The previous figure is from Bernd Schneider’s site. The light-cone is described by the yellow lines, which stand for the world-line, or ‘cosmic path,’ of light. All communication for a stationary observer must take place within his light-cone otherwise causality would be violated. Let us consider the four marked events which could be star explosions (supernovae), for instance. Event A is below the x-axis and within the light cone. It is possible for the resting observer at O (‘here and now’) to see or to learn about the event in the past,

since a  $-45^\circ$  light beam would reach the t-axis at about one and a half years prior to  $t=0$ . Therefore this event belongs to O's past. Event B is also below the x-axis, but outside the light cone. The event has no effect on O in the present, since the light would need almost another year to reach him. Strictly speaking, B is not in O's past. Similar considerations are possible for the term 'future.' Since his signal wouldn't be able to reach the event C, outside the light cone, the observer is not able to influence it. It's not in his future. Event D, on the other hand, is inside the light cone and may therefore be caused or influenced by the observer.

A well-known paradox concerning a journey in time is the grandfather paradox. According to Wikipedia, it was first conceived by René Barjavel in his 1943 book 'Le Voyageur Imprudent.' The paradox is described as following: the time traveler went back in time to the time when his grandfather had not married yet. At that time, the time traveler kills his grandfather, and therefore, he is never born when he was meant to be. The paradox's namesake example is merely the most commonly thought of when one considers the whole range of possible actions. Another example is to invent a time machine, then go back in time impeding its invention. An equivalent paradox is known as auto-infanticide, going back in time and killing oneself as a baby.



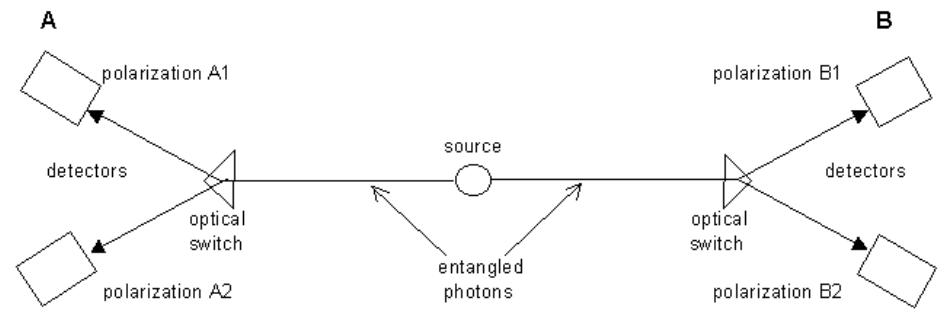
The extended present represented as a circle extending beyond the light-cone, into the 'forbidden' area, where events C and B are found.

Despite the name, the grandfather paradox does not exclusively regard the impossibility of one's own birth. Rather, it regards any action that makes impossible the ability to travel back in time in the first place. Indeed there is a fundamental difference between causally violated and causally

unrelated events. Events B and C that were previously described in the light- cone figure, are causally unrelated to the observer because he cannot have knowledge of them, not in the sense of any local means of communication. If he could have knowledge of them, causality would be violated because there would be a faster than light transmission of information. In the same sense, if event B or C represented the death of the observer's grandfather, then the observer wouldn't have any sort of immediate access to these events in order to cause his grandfather's death.

But in the framework of the extended present, 'here and now' is not a single point in space-time but it has dimensionality. So the observer's present extends in an area, as is depicted in the previous figure, for example forming a circle, which includes parts of 'elsewhere' where events B and C take place. The shape of a circle was arbitrarily chosen for reasons of convenience, and the cycle itself may be disproportionately large with respect to the light- cone, for the sake of comparison. Nevertheless, events B and C are now connected, even if not causally related, to the observer. Event B may be regarded as past- like, and event C as future- like. Thus, even if he has not any direct access to them, he has some indirect knowledge of them. This non- local connection between the observer and the events, may acquire a 'notion of space- time' at the later stage of causal relation. At the moment, I am not aware of any act of consciousness that could deform the light- cone in order to causally relate events B and C as its own 'real' past or future, respectively. I don't even know if the previous thought has any meaning. In any case, the process according to which consciousness attributes time to events does not imply a physical travel in time. Instead it represents an event in the extended present, that is going either to take place in due time or to remain conditional forever.

## Quantum-mechanics and non-locality



Alain Aspect's experiment on quantum entanglement. The source produces a pair of entangled photons which travel in opposite directions. Each photon encounters a polarizer (optical switch) and its polarization is counted by detectors. The orientation of the polarizer can be set by the experimenter during the flight of the photons, so that if one photon is 'up' polarized, the other one will be 'down,' even if the entangled pair is separated by an arbitrarily large distance. (Image taken from the website of Stanley Sobottka, University of Virginia)

According to classical physics and thinking, objects have predetermined properties. Consequently, observation doesn't change these properties and does not affect the observed objects. Furthermore, objects are supposed to have been existing, before they were observed. But the truth is that before we observe things we know nothing about their properties and states. For example, even if the moon had already existed before we first observed it, our action somehow imposed a new condition on the moon, the stars and the universe.

We may not affect celestial bodies by observing them, but in the microcosm things are different. Quantum mechanics has showed that the properties of microscopic systems change by observation, so that a system has no predefined properties by itself. Instead it is said that the system is in a state of superposition, until a measurement is made. At that moment the observed property of the system takes a definite value. However, this probabilistic interpretation led to a paradox. If the properties of a system are determined at the instant of observation, then we may affect its distant parts instantaneously. Take for example an isolated system consisting of two objects. Conservation of momentum requires that any change in one part of the system will be accordingly transferred to the other part. But if the properties of things are determined at the instant of observation, then the change in one part would be transmitted instantaneously to the other part. This paradox is what Einstein called 'spooky action at a distance.' He had also set up a thought experiment, called the EPR paradox, in order to demonstrate his argument. However, this thought experiment has been confirmed by Alain Aspect's experiments on quantum entanglement, and has been theoretically described by the so-called Bell's inequalities.

As far as Bell's inequalities are concerned, they calculate the correct probabilities for the non-local correlations between the two parts of the entangled pair. They don't state anything about the process. But the fact that we don't know anything about the state of things before we observe them

is more or less self- evident. So at the moment of observation we are met with the simultaneously collapsing wave- function of the system. Thus the whole process seems like a causal loop generated and dissolved by the experimenter. But the observer does not perform his experiment in a passive way. He participates and he also determines the values of the system at the moment of observation, when the system's wave-function 'collapses.' This is the observer effect in quantum mechanics. Schrödinger's cat is a good example: the observer determines if the cat will die or stay alive, depending on the conditions set by the experiment.

The observer effect implies more than just a process which can be defined and measured. It suggests that there is a kind of connection in the world, a participatory principle, which binds things together in a very special way, regardless of distance. Consciousness is an integral part of this process, so that it neither determines nor is determined by the process. Rather it emerges from within the 'relics' of the collapsed wave- function in order to rearrange the pieces in an appropriate order. The underlying mechanism of quantum entanglement is unknown. Niels Bohr talked about the indivisibility of action. Quantum- entangled systems seem to form a 'unity' in space and time, including the observer, so that any change of state makes the wave-function collapse, instantaneously and everywhere. Quantum teleportation is a consequence of quantum entanglement, where the system is prepared in such a way that its properties may reappear instantaneously at an arbitrary distance. Consciousness seems to be an extended event that constantly collapses everywhere, in the past and in the future. I don't know if consciousness is a 'microscopic' or 'macroscopic' object or something else. But its dimensions and extensions far beyond the 'common ground' of naïve, linear causality should be indicative of the way nature works at a fundamental level, also very promising with respect to a better understanding of our own.

Quantum entanglement is a process of the microcosm, concerning particles, molecules, even crystals, not macroscopic objects or beings, such as humans. But its implications could play an important role with regard to many sections of modern science, like computer technology and neurobiology. According to Sheldrake, Christopher Clarke argues that entanglement is an essential aspect of conscious perception. Consciousness itself somehow arises from entangled systems: "If the qualitative aspect of perception is produced by quantum entanglement between the states of

the brain and the states of perceived objects, then the supports of conscious loci are not just the brain, but the whole of perceived space.” Clarke further suggests that in living organisms quantum entanglement may help to account for their holistic properties: “If we consider a living, and hence coherent, entity, then the entanglement will take over the individual states of the parts, which will no longer be definable, and replace them with the quantum state of the entangled whole.”

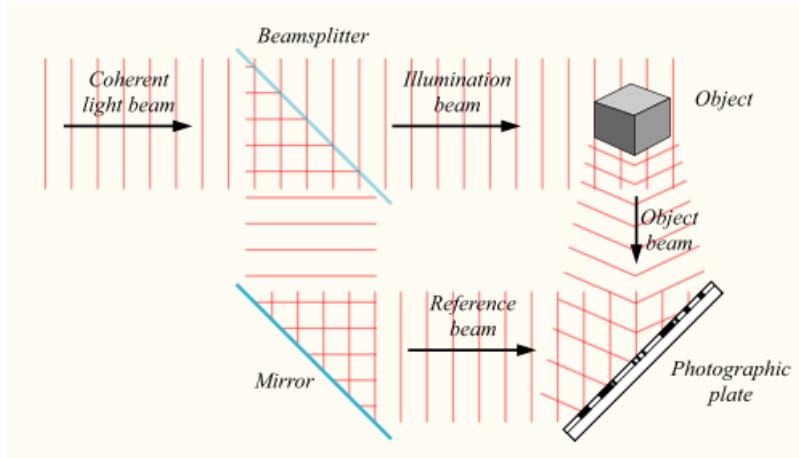
Can quantum entanglement be transferred to the macrocosm? In a way the multiverse theory is such a transfer. The parallel universes, that constitute the multiverse, are in a sense entangled, so that at the moment of quantum ‘decoherence,’ when the wave- function of both the observer and of a parallel universe collapses, the observer may pass from his world to the parallel universe. This ‘parallel’ universe becomes then his new world. In fact all events of the microcosm reappear in the macrocosm. We are macroscopic entities that consist of microscopic ones. Consciousness also exhibits non- local characteristics, as it is able to ‘travel’ from one place to another instantaneously. Does consciousness make this journey in space-time ‘physically’ or ‘mentally,’ ‘microscopically’ or ‘macroscopically,’ and what is the difference? It seems that the distinction between ‘small’ and ‘large’ things is a matter of compositeness. The more an object can be divided in constituents, the ‘bigger’ it must be. But in fact this is an analytical process that has nothing to do with ‘size.’ Consciousness itself consists of many events that take place simultaneously, so that it emerges as a certain configuration of these events at a certain point in time. But all these events are equivalent, yet unrealized, modes of the same consciousness. Let’s not make things harder at the moment by assuming scales within scales, loops within loops, minds within minds, etc. But the truth is that consciousness consists of many events as much as it is an ‘elementary’ event itself. Furthermore, all the events that consciousness consists of may assume not only spatiality, some volume for example, but also temporality, so that in turn consciousness gains a ‘qualitative extension,’ an ability of self- imposing configurations that constantly alter the order and measure of its natural landscape.

Consciousness is not just a passive procedure that consists of ‘superimposed’ events. It is a spontaneous and independent mechanism of action and reaction that may determine which state of an event or of a set of events will be manifested against all the others, by an act of ‘self- awareness.’ This way consciousness naturally evolves in a step- by- step causally described progress.

Nevertheless its origins are found in another world where spontaneity rules. The underlying mechanism of the conscious mind is found in the unconscious. There, spontaneous inference of reality gives rise to the possibility of a non- locally interrelated set of things at the smaller scales, which nevertheless may be expressed at the larger scales of the universe. Time ‘travel’ itself is paradoxical if we regard it as a linear succession of causally related things. But in the framework of the extended present, events are already connected or ‘entangled’ by the infinite loop that originally comprises them. Events may appear separated in space and time so that they exhibit some ‘notion of the future’ or of the past, but only retrospectively and at a causally ‘retarded’ phase. Our consciousness spans the extended present, arranging events according to conditions and pre-conditions, thus recognizing a future and a past respectively, choosing each time a special event, the present, which all other events refer to. It is this kind of reference, which in fact is self-reference, that shows that the future or the past cannot ‘interact’ with a point-like ‘here and now’ at a distance, unless they exist in a conditional state within the broader context of the extended present.

## **Holograms and the holographic principle**

The underlying processes that take place at an unconscious level predispose rational thinking. While the latter is analytical, the former is holistic. The extended present seems like an unknown universal ‘field’ stretching out in space-time, connecting events instantaneously. So it corresponds to the unconscious and extends beyond any analytical power of the brain. If we would like to conceive such a fundamental and holistic aspect of things with respect to the notions of space and time, we would rather imagine a property of the world such as to contain the whole in the parts. Thus it would be easier to deal with the problem of symmetry and simultaneity in nature.



Recording a hologram

An object that possesses such a holistic property, to contain the whole in each of its parts, is a hologram. Following Wikipedia's description, a hologram requires two laser beams in order to be formed. When these two beams reach the recording medium, their light waves intersect and interfere with each other. It is this interference pattern that is imprinted on the recording medium. The imprinted scene can later be reconstructed when the original light field and the illuminated object are no longer present. Holography is a technique that demands certain conditions, such as lasers with fixed wavelength, dark rooms, and recording plates. Still the principle on which holography is based is rather intriguing and simple: "The whole is contained in each part."

Could the brain work in the same way, not only inferring the whole from the parts but also containing the whole in each part? The holonomic brain theory is originated by Karl Pribram who noticed that rats didn't forget to perform tasks even if large parts of their brain were removed. In this model, each sense functions as a lens, refocusing wave patterns either by perceiving a specific pattern or context, or by discerning discrete grains or 'quantum units.' According to Wikipedia, Pribram says, "What the data suggest is that there exists in the cortex, a multidimensional holographic-like process serving as an attractor or set point toward which muscular contractions operate to achieve a specified environmental result. The specification has to be based on prior experience (of the species or the individual) and stored in holographic-like form."

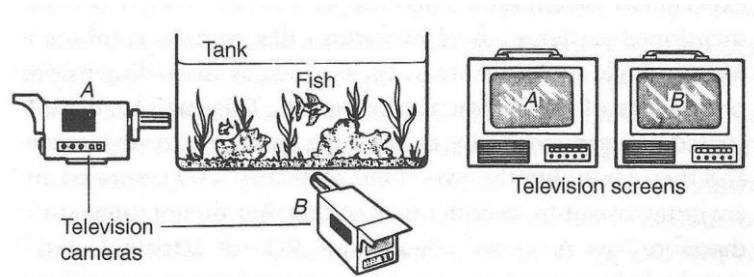


Figure 7.1

A simpler description of the phenomenon is given by David Bohm who employed the hologram as a means of a characteristic ‘implicate order,’ that is order hidden at a deeper level of reality, and which is manifested, or becomes ‘explicate,’ in our world under certain conditions, such as the observable results of our own experiments. In his book ‘Wholeness and the implicate order,’ Bohm explains, “There is the germ of a new notion of order here. This order is not to be understood solely in terms of a regular arrangement of objects or as a regular arrangement of events. Rather, a total order is contained, in some implicit sense, in each region of space and time.” He also asked us to consider the possibility “that physical law should refer primarily to an order of undivided wholeness in a content of description similar to that indicated by the hologram rather than to an order of analysis of such content into separate parts ...”

What this means may be depicted in the previous figure, taken from Bohm’s book: Let’s suppose that we have a tank filled with water and that two cameras take shots of a fish swimming in the tank. Each camera monitors the fish at a different angle. If the two different images of the fish were projected on two screens placed in another room, a spectator in that room would imagine that there were two different fish swimming in the tank. Only if he saw the original tank and the cameras would he realize the illusion.

Is separation in space (and time) an illusion? Perhaps yes in some sense, but what may be more important is the causal relation that we attribute to things. In Bohm’s paradigm the two events (the two images of the same fish) don’t interact with each other, so there isn’t any causal relation between them. We often attribute to events causal relations that create an arbitrary spatial or temporal division while the justification is that we are simply unable to perceive more than one event at the same time. We would need then an extra- ordinary intelligence or a super- computer

that could perceive or process all events at once. This super- intelligence could also be able to deduce the totality of the world using as less information as possible. It would be a holographic super-computer. But despite its unlimited power, his basic function would be quite simple: A grain of sand comprises the universe.

This is a way to express what is called the holographic principle. This principle was developed from quantum gravity as an explanation of the so- called black hole information paradox. A black hole literally swallows everything passing through its event horizon. Since matter and energy is information, a black hole consumes information, which is lost behind its event horizon. But information is supposed to be conserved, just like matter and energy. So where did lost information go?

According to Wikipedia's description, Gerard 't Hooft analyzing the lost information paradox found out a way in which incoming particles can modify the outgoing particles. Their gravitational field would deform the horizon of the black hole, and the deformed horizon could produce different outgoing particles than the un- deformed horizon. This idea was made more precise by Leonard Susskind, who argued that the oscillation of the horizon of a black hole is a complete description of both the in- falling and outgoing matter, in the same way we recover the information contained in a holographic plate by illuminating it and producing a hologram. We may now give a simple definition of the holographic principle, as given by the site physics.about.com: "The total information contained in a volume of space corresponds to an equal amount of information contained on the boundary of that space." This dependence of information on surface area, rather than volume, is the key principle. As Brian Greene put it, "The holographic principle envisions that all we experience may be fully and equivalently described as the comings and goings that take place at a thin and remote locus. It says that if we could understand the laws that govern physics on that distant surface, and the way phenomena there link to experience here, we would grasp all there is to know about reality."

So where could we find such a holographic surface? In fact any area may exhibit such a property. For example, the walls of our room, including the floor and the ceiling, may represent all the events that happen inside the room. The event horizon of the universe itself forms such a surface on which

all its history could be traced. This would be the greatest discovery of all times, out of which we would build the theory of everything, and learn about the fate of the universe and our own fate, at present. But fate is nothing more than all the pre-conditions and conditions, that is the chronological assumptions about our next or previous positions. In a more formal way, we may assume our space- like or time-like cosmic paths, even the change in the course of history, by using closed-time curves. So is our fate predetermined? Not so, because as we consider the past and the future, this consideration always takes place at present. The extended present may be thought as having its own event horizon, regularly violated by ‘incoming’ and ‘outgoing’ events, which represent instantaneous depictions of the ‘primordial past’ and the ‘ultimate future.’ However, although these events, in a sense, have already happened, they exist as conditions, with reference to the present, not as facts. So, at the boundaries of the extended present, we are not confronted with an ‘ultimate fate’ but, more likely, with an ‘ultimate condition’ yet to be realized.

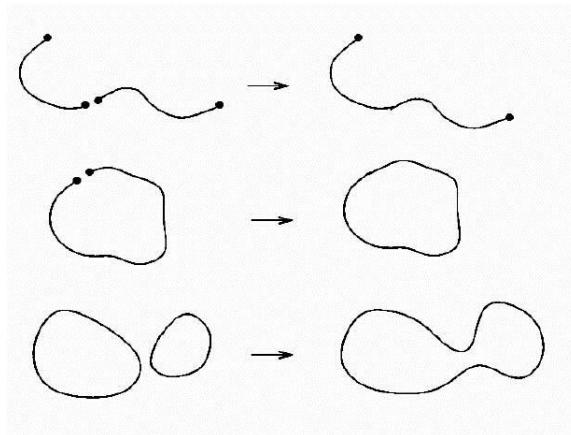
Whatever the outcome of contacting or entering an event horizon may be, we should keep in mind that all these considerations are events of consciousness. Is the universe really out there, or is it a mere representation of consciousness which might stand as a self- referential and ‘impossible’ object? Is the universe really expanding, or is it just consciousness ‘propagating’ in its extended present? According to the participatory principle, these two assumptions are, remarkably enough, equivalent. It seems that we live ‘outside,’ as well as ‘inside’ an event horizon forming the boundaries of an expanded singularity. Is this the event horizon of our consciousness? Do all events have their own event horizon- a hidden, inaccessible area, according to the properties of light and to the actions of conscious observation? We could say that in the same sense that light is bounded by its own speed, consciousness is selection- limited. So consciousness may have its own event horizon, identified with the limits of an infinite causal loop. The extended present is also an infinite loop consisting of pairs of ‘incoming’ past-like and ‘outgoing’ future-like events that occur on the surface of its event horizon. So, its true extent is not determined by space- time distance, which has to do with retrospective causal considerations of consciousness, but by primary time- like conditions, which take place non- locally and spontaneously throughout its whole territory, and simultaneously at each of its points.

## Aspects of the extended present

The world that we live in does not exist independently as a separate external object, but it is constantly changing because of conscious intervention. This is what the participatory principle demands, so that the properties of things always depend on free will, which determines what is going to be measured. Accordingly, when consciousness picks up some event instead of another, it simultaneously assumes the spatial and temporal character of this event. Before this conscious action of chronology determination, the event was itself conditional. Even if an event is regarded as ‘well- recorded history,’ it is always considered at present, so that it gradually gets distorted by other contemporary events, such as thoughts and feelings, or social and political new trends.

The extended present is the natural space of consciousness, where all these trends and attitudes take place, while the events are constantly rearranged and reconsidered in space and time. Let’s think about it for a while: Even the most undisputable historical fact is nothing more than a commonly accepted truth about some event, which may be revived but will never be reborn. As far as the future is concerned, the previous realization is easier to be supported. The future is conditional anyway, so that there is no point talking about its rebirth or revival. But in the framework of the extended present, the future and the past are equally conditional, and the infinite loop that encircles both events is, more or less, simultaneous. So both events are at a primal level interchangeable and equivalent; that is before one throws the arrow of time towards the direction of one event or the other.

## Events are not point-like



In string theory, particles are not point-like, but extended objects consisting of strings

(<http://theory.tifr.res.in/~mukhi/Physics/string2.html>)

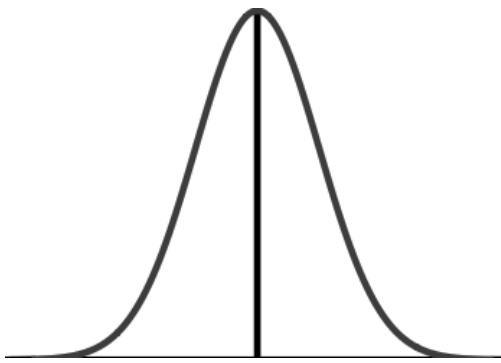
In Newtonian physics a point-mass is an idealized representation of a physical object that simplifies calculations. Thus we ignore the object and instead we draw attention to its interactions with other point-like objects. Nevertheless, if objects were point-like no interaction could take place in the real world. For example gravity, which obeys an inverse square law, would be infinite in the case of point-like objects in contact. Furthermore, even if we assume that all properties of an object are gathered at a point, the so-called center of mass, its motion, when space-time is considered, describes areas and volumes, so that the effects on space-time and other moving objects are extended, real events.

In fact objects do affect space-time. They deform it, in some sense, and they justify its existence by their motions or even by their mere physical presence. Without ‘things’ space-time would be an absolute void, relative to nothing. Objects themselves are events which occupy space-time. So they have dimensionality. And as they have a ‘back’ and a ‘front’ or a ‘bottom’ and a ‘top’ in space, so they have a ‘past’ and a ‘future’ in time, with respect to another event that holds a special place in what we call ‘the present.’ But in turn the present is an object itself, so it can’t be dimensionless. It occupies and forms space-time too. This is the meaning of the extended present: It has dimensionality and limits, therefore it contains at present the future and the past.

Is the ‘future’ or the ‘past,’ according to the context of the extended present, different from what we commonly refer to? We regard the past and the future as distinct from the present but in fact we regard them *at present*. We go ‘back’ and ‘forth’ in time from the present to the past or to the future respectively, to discover or imagine events which are related to personal or collective experiences and expectations. Anyway, these events are conditional both subjectively and objectively. It is an ‘image’ that is brought forward at present, while the ‘real’ event always happens at ‘another’ time. Even the present, if it is considered point-like, becomes an elusive ‘spot’ in consciousness, rapidly succeeded by similar, momentary ‘present times.’ But consciousness doesn’t really get lost in this infinite succession of point-like present times. On the contrary, consciousness seems to be aware of the chain’s full length. This is why consciousness

has the properties of an infinite loop. It contains the infinite chain of its moments, and as a matter of a fact it twists it round performing the loop of its extended present. Consciousness not only is capable of encircling the space-time of its existence but also it may easily recognize its extended presence spanning the full scale of time. One way or another, each event that consciousness considers becomes a representation of another time in the present time, so there isn't any contiguous notion of the 'past' or the 'future,' only their live performance at the stage of the extended present. Consciousness does not consist of a time-chain of present-time points fading away one after the other. Instead all points may be considered at some time, in the future or the past, 'brighter' or 'fainter,' but always at present. This is the main difference.

Events are considered at present



Gaussian type 'wave-function' depicting the notion of the extended present: An event spreads out in space and time from the peak of the curve, at present, towards infinity. At the edges of the distribution, the event is considered either past-like or future-like. Perception of the event can be focused anywhere along the space-time distribution, so that when the wave-function 'collapses' at present, the 'snapshots' of the event depict successive periods of time. The same function may also represent a set of events, each of them distributed in space and time, within the framework of the extended present. In this case, 'recent' events occupy the space near the peak of the distribution, while 'remote' events are found at the limits.

Whatever the views about history or the thoughts about our lifetime may be, it is true that all considerations take place at present. Even when we have to deal with past or future events, we recreate them at the present state of our consciousness, as if they had existed 'here and now.' This is a simple and inescapable fact of our own extended present. The extended present does not

include ‘real’ past or future events, but events that can be regarded as ‘past-like’ or ‘future-like,’ respectively. The existence of our ‘past’ or ‘future’ is just an assumption we make about an event saturated with our present state. We don’t really travel to the past when we remember things, nor do we physically visit the future when we think of it. But we assume what the future will be like or consider past events, at present. So the future and the past exist within the boundaries of the extended present, in a literal sense. On the other hand, events are extended objects, ‘filled’ with space-time, which they may define and change. So we may say that an event exhibits a ‘past-like’ or ‘future-like’ behavior within the framework of its extended present. This varying temporal aspect of events may be subject to parallel considerations at present, but also remains temporally unrestricted, stretching to infinity.

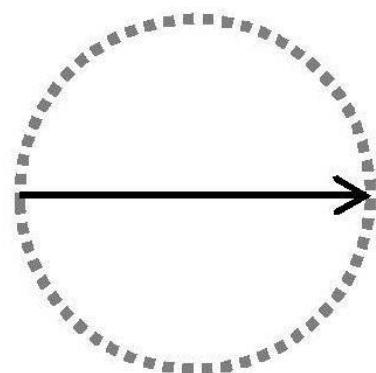
A Gaussian function, such as the previous one, may represent in a pictorial way the aforementioned kind of spatial and temporal expansion. The peak represents the present, an event that has the greatest ‘intensity.’ This is also the most probable event with respect to the present. The probability gradually decreases but never goes to zero. This means that the past-like or future-like characteristics of an event spread to infinity, even if the event occurs at present. If we identify the probability with intensity, then an event gradually fades away, symmetrically with respect to the peak, towards the limits of the distribution. When consciousness considers events, they acquire the maximum degree of intensity at present, while past or future events are faint in perception, as if consciousness regarded them ‘at an angle.’ The fainter events appear in consciousness, the more remote they are considered to be, in the past or in the future. But when consciousness picks up an event from the past or the future in order to reconsider it, then this event is anew ‘saturated with the light of consciousness.’ Yet, while the event is being examined at present, it is not regarded as belonging to the present. This is why we say that it is ‘past-like’ or ‘future-like.’

An amazing and rather peculiar property of the wave-function is that it ‘collapses’ simultaneously everywhere. This means that if we have a collection of events, the ‘wave-function’ of the collection collapses in such a way that the events will appear specifically distributed in space and time. Consciousness will retrospectively sweep the distribution of these events in order to give them some spatial and temporal property. May consciousness make the wave-function of the collection of events collapse? Quantum-mechanically the answer is yes. More generally, since

events are observed and assumed by consciousness at present, we may say that consciousness makes distributions of events ‘collapse’ all the time. So this seems to be the standard mode of the function of consciousness. But as we are unable to regard more than one event at a time, consciousness has to choose which event represents the present, so that the rest of the collection will be distributed in the ‘future’ or the ‘past.’

The same is true for a single event. If we regard it as the distribution of an extended object, then, as soon as consciousness makes it collapse, its parts will be spread in space and time, according to a mechanism of causal selection that consciousness will employ at present. Consciousness itself may be considered as an extended object consisting of spatially and temporally distributed events. While consciousness upgrades one of these events to the present, it updates the rest of them, ‘remembering’ the past and ‘imagining’ the future. This description is not irrelevant or contradictory with respect to our notion of space and time because we may regard the extended present as a collection of events which collapse simultaneously at the moment of conscious observation, so that each of them assumes a different degree of intensity and importance. The less intense an event is regarded by consciousness, the more it is displaced at the edges of time, while the most intense event will stand for the present. The instantaneous collapse of the distribution of events guaranty as that everything happened at an instant of time which can’t be anything else but the present. But all other events collapse at the same instant too. So they don’t really belong to the future or the past but to the extended present.

Events happen at two phases



Representation of instantaneity with a two- phase mechanism: The circle represents the first phase of spontaneous creation of an event. The arrow represents the second phase of local propagation of information concerning the event.

All events are considered at present, even though they may belong to another time. The distribution of events in space and time is analogous to the intensity attributed by conscious attention. Although consciousness can be regarded as an extended event that collapses simultaneously and everywhere, analytical reasoning needs time in order to arrange the events according to some spatial and temporal classification. This process has to do with causality and takes place retrospectively. The principle of causality, or equivalently of locality, is related to the speed of light. Information cannot travel faster than light from point to point, so that even if the wave- function collapses non- locally (i.e. simultaneously) time will pass before any event is causally communicated. Still the collapse has already occurred, so that the idea of simultaneity becomes fundamental and dominant at an initial stage.

The spatial and temporal extension of events beyond their state at present has been confirmed experimentally and also regarded theoretically. For example, according to the Aharonov- Bohm effect in quantum- mechanics, as described by Wikipedia, an electrically charged particle may be affected by an electromagnetic field, despite being confined to a region in which both the magnetic and electric field are zero. The previous effect is related with what is called quantum tunneling, where a particle has a non- zero probability to appear in a ‘forbidden’ region. This phenomenon, as well as others of the same kind, can be explained in the framework of the extended present in connection with the notion of simultaneity. The particle itself is an extended object, initially spanning all space-time. After its wave- function collapses, information propagates and causally relates the particle to the external electromagnetic field. This faint interaction is the remainder of an underlying process, during which the two events co-existed simultaneously.

Bohm also introduced the notion of a quantum potential in order to explain such phenomena of simultaneity. This kind of potential corresponds to the initial phase of an ‘implicate’ order that supposedly predates the ‘explicate,’ causal manifestation of the phenomenon. This preceding phase coincides with the super- imposed states of a quantum- mechanical system, before the collapse of its wave- function, and also describes the undetermined temporal properties of events

before the action of conscious observation. Besides simultaneity, this view may as well explain the premonition we often experience about future events. Since conscious realization of events is a strictly causal process, the perceptibility of their initial state must be related to the unconscious. The collective property of unconscious inference, which was previously discussed, fits well with the universality of the extended present. Different states of events pre- exist as conditions or potentials not yet causally processed or ‘propagated.’ Without the local propagation of information, even space-time may not yet be realized. So at their initial stage events may appear spontaneously and may extend instantaneously. At the moment when the wave-function collapses, simultaneity appears to be ‘smiling in a snapshot,’ just before things get back into line.

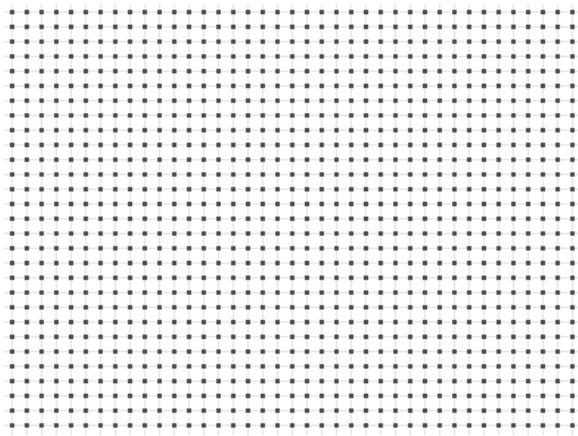
Consequently, we may divide physical processes into two phases. The first one is implicate and unconscious, space- less and time- less, non- local and non- causal. No information or knowledge is transmitted or communicated. Therefore events at this first stage are not causally related but spontaneously connected to each other. The second phase is explicate, conscious, and ‘filled’ with space-time. Information is propagated locally and events acquire causal relations, while consciousness attributes spatial and temporal meaning to them.

So the extended present may be considered as the background on which the potentiality of events depends, before it is expressed and realized. At the moment of observation events acquire a distinct form and a certain meaning, against a formless and invariant background. They obtain a past and a future relative to our memories and expectations, respectively. Furthermore they are given a cause, according to our own purposes and directions. However, the conditions, or ‘super- imposed’ states, of events already exist within the background, which may be thought as ‘turbulent,’ rather than still. Some people believe that information contains an intrinsic ‘meaning,’ so that causal processes may be spontaneously initiated, without the assistance of some sort of ‘divine intervention.’ This may be true, but the aspect of a self- organizing property of matter, or information in general, implies a kind of intelligence that is included. The name of this special property of information is consciousness. But consciousness is not only a product, but also a catalyst of natural spontaneous processes. It is able to dissolve the infinite loop of conditionality and make the distribution collapse. From this point onwards, consciousness gets involved in the process of giving ‘reasonable’ form and content, with respect to space and time, to things gathered

from the relics of a spontaneous explosion that took place at the primal and unconscious level. So it is consciousness versus the background.

The deepest aspect of consciousness may reveal the origins of the universe itself. It is believed that the universe began to exist after a ‘Big Bang.’ This is a rather accurate description of the birth of an infinite loop, a gigantic one in this case. This was also the moment that the universal wave-function collapsed, exposing a certain configuration of cosmic events. The extended present of the universe was then born and it is still expanding. But at the level of consciousness this expansion is artificial and secondary, covering with light the relics of the initial infinite loop in the background. “Is the universe expanding, or is it just consciousness ‘propagating’ in its extended present?” we could ask again. And what is the difference? As far as the universe is concerned, it is considered homogenous at a large scale. But when we focus our attention on clusters of galaxies, we begin to discern irregular regions of high intensity, against a pervading, empty space. According to the degree of intensity we then find which cluster is older than another, and we consider that the age of the galaxies is proportional to their distance with respect to us. An analogous procedure goes on in our minds. Our own ‘universe of thoughts’ is full of facts and events that possess a different degree of intensity. The more intense an event is, the closer it is found, with respect to the present, in the ‘space-time’ of our memory. And each time we pick up a certain event to stand for the present. But if we regard events as past- like or future- like, and if we consider the fact that all galaxies in the universe consist of different amounts of energy density, then we may realize that all facts of consciousness, belonging either to the past or to the future, are the ‘stars’ of focused attention on the invariable cosmic background of the extended present. So the answer to the previous question is based on scale equivalence.

## Events are not causal by themselves



A grid depicting the notion of simultaneity: Each point represents an event. All events may be considered happening simultaneously, at the first place. Information traveling from point to point generates a causal relation between the events, at the second place.

When we think, we are used to imagine a linear succession of events, somewhere in our minds, in such a way that they form a causal chain of cause- effect pairs. Maybe we were just taught at school that this is the right thing to do, despite the fact that all of us, deep inside, still believe in miracles. But schools of thought have nowadays changed. The laws of nature are not considered deterministic anymore. It seems they have not existed at the beginning of the universe, but took their form at its early stages, and they may still evolve. This probabilistic character of physical processes becomes more obvious at the microscopic scale. Particles are not found at a certain position, but they follow unpredictable orbits, moving backwards and forward in space and, perhaps, in time. The wave- function is a probability distribution covering an area in which a particle can be found. Nevertheless, according to the uncertainty principle, the more we observe a particle the more we disrupt it. If we make a measurement of its momentum, for example, we increase the uncertainty of its position, and vice- versa. Consequently, the pre- determined trajectory of a point-particle in classical physics has been replaced by the probability distribution of an extended object in quantum- mechanics.

The uncertainty principle could also be called the complementarity principle. The Gaussian wave- function exactly expresses this complementarity, as events may acquire a maximum degree of

correlation, like a perfectly symmetrical ‘eight’ with its two parts equal in size. Each time we bring together the two ends of a line, we form a loop through an extra- dimension. In this case the extra- dimension is ‘width.’ The holographic principle states in turn that a ‘third’ dimension is not needed, because all information is contained in the ‘surface’ of the loop. Each time that we think about a loop, we perform at the same time a thought experiment concerning a journey in time. Quantum entanglement suggests that this is where the two ends of a line should meet in a ‘real’ experiment. Quantum tunneling also suggests that the choice of the two ends is arbitrary, so that ‘microscopic’ objects may violate the usual order of ‘beginnings’ and ‘ends.’ Equivalently they may appear to be at two or more places simultaneously, as if there existed a single infinite- dimensional object in the world, while all other objects would be its reflections. Particles, for example, may be thought as parts of objects extended in extra dimensions. One way or the other, either there is a single extended object in the universe comprising everything else, or there exist an infinity of different, quantum- entangled things, we are faced with a totality simultaneously evolving in the extended present.

The grid in the previous figure depicts such an idea. The evenly distributed dots may represent events in space- time. Imagine, for example, what goes on each time we turn on the light. We know that light propagates with a certain speed so that it needs time to cover the room, even if it travels fast enough to give the impression of simultaneity. But let’s imagine a pre- existing condition, just before we turn on the light, which predisposes the paths that light will follow. This kind of ‘potential,’ which David Bohm called quantum potential, will have already covered the room, before light propagates. There are two ways to interpret such a process. The first one is to assume a faster- than- light transmission of some sort of ‘quantum information.’ The second one is to preserve locality and assume an extra- dimension. In the former case, we should revise the meaning of ‘information.’ In the latter case, light can be treated as the ‘projection’ of an object extended in an extra- dimension.

Does this pre- condition, this sort of a new ‘field’ which assumes physical existence, solves our problem, or does it make it worse? This idea of some sort of substance permeating space- time is not a new one. In ancient times, it used to be identified with the ether, while in modern times it is called the vacuum. The probabilistic, potential paths of a supposed field forming the background

of space- time may be compared with the virtual paths that the brain constructs in order to determine the position of an external object. They may also explain how a photon seems to ‘know’ which slit is closed in Young’s double- slit experiment in order to choose between its wave- like and particle- like appearance. This kind of ‘hidden’ field may also explain the appearance of a particle in a ‘forbidden’ area, in quantum tunneling.

This sort of theories that suppose a ‘hidden’ variable are thus called hidden variable theories. Bell’s inequalities showed that a hidden variable theory cannot explain the results attained by quantum mechanics. However, a non- local hidden variable theory, such as that of David Bohm’s quantum potential, may incorporate non- local correlations, such as those that may take place in quantum entanglement. Still, there are two basic approaches with respect to the problem of simultaneity: Either we accept the principle of causality so that we assume a ‘hidden’ field travelling faster than light, or we forget about the whole story of determinism and instead dive in deep, new waters, searching for a completely different approach to the whole situation. In the latter case, the non-local approach generally accepts ‘parallel’ syllogisms in order to avoid any conflict with the principle of causality. Such an approach is the multiverse theory, according to which non- locality may be explained with the help of ‘parallel universes.’ In quantum entanglement, for example, the particles could ‘jump’ to a parallel world, and then return to our own world, accordingly polarized, in different places ‘simultaneously.’

I don’t know if such ‘parallel’ theories make things easier than ‘hidden’ ones. Generally speaking, such parallel approaches give rise to extra- dimensions. In string theory, for example, particles are thought as different modes of multi- dimensional vibrating strings leaving their traces in our lower- dimensional world. M- theory regards 10 or 11 dimensions, enfolded in space- time at microscopic scales. Nevertheless, no matter how we could visualize an ‘extra- dimension,’ simultaneity seems to be one of its fundamental properties. A set of events that are parts of an extended object that lives in a ‘higher’ dimension, collapse instantaneously in our world so that they are found distributed at different places at the same time. This process is non- local by nature, because no information necessary to establish a causal communication is involved. Furthermore, at this deeper level of reality, space- time is not yet realized in any familiar form. So it is highly doubtful whether a multi- dimensional approach will solve the problem of simultaneity in nature, because extra-

dimensional objects seem to be fundamentally space- less and time- less. Moreover, if we regard the possibility of an instantaneous causal interaction, then we should ask ourselves what sort of ‘propagation’ could carry no information at all.

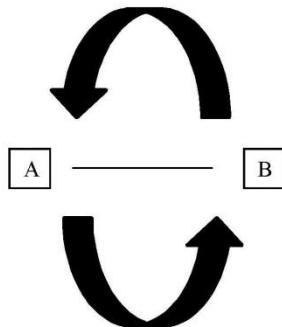
Even if we can somehow grasp the meaning of non- locality with respect to space, the same notion with respect to time is much harder to perceive. Moving ‘backwards’ or ‘forward’ in space is different than doing the same in time. We are not supposed to move back and forth in the ‘past’ and in the ‘future.’ The arrow of time always moves forward and we never become younger, even if we ‘visit’ the past. However, the thermodynamic property of things to wither doesn’t necessarily reveal the nature of time itself. Time doesn’t wither; it just goes on. And at a deeper level of reality time may not even exist. If we regard the universe as a uniform, single body, it is remarkable how it is able to sustain its volume and equilibrium, against all the violent cosmological phenomena, such as black holes and super- nova explosions, which take place at enormous distances, with respect to each other. How does light or information in general, succeed in reaching the most remote places of the cosmos? How come the universe has not yet fallen apart? A new discovery of modern cosmology is the so called dark energy. It is related to a force that is found to be proportional to distance. Can this newly discovered force cover the ‘void’ in our understanding the nature of the cosmos? This force indeed is related to vacuum energy. It is as if it covered the empty space left behind by the expansion of the universe. Yet, if causality is to be sustained, this force will not travel faster than light, even at the most distant areas of the cosmos.

The mystery of simultaneity in nature reflects upon the spontaneous processes occurring in our minds, at the deeper level of consciousness. The unconscious performs an automated task of form inference. Consciousness then reconstructs these ‘primal forms,’ using logical channels of reasoning. However, not only we may spontaneously approve raw and logically unprocessed material of the unconscious, but we can also succumb to its power. Generally speaking, the more intense or familiar an event is, the easier it bypasses logical channels and it is registered uncensored in memory. Our mind is full of preconceptions that we may have never put to the test. We are used to attribute to things causal relations that may not exist. We say for example that nothing can travel faster than light, without really understanding the consequences with respect to space and time: Length contraction and time dilation. How much may space- time ‘bend?’ Can we travel

instantaneously from a point to another? Can we make a journey into time? It seems that some of these strange pre-existing notions have somehow been explained on a logical basis, at the level of conscious realization. We could consequently suggest that what changes each time is our conceptual framework, not the essence of things. And this ‘essence’ is the spontaneous characteristic of natural processes at a deeper level of consciousness. Are we unconsciously familiar with the notion of simultaneity? It’s true that if we reflect what time really is, we will soon realize that it is a property deeply rooted within consciousness. It certainly has to do with memories, which is information with a specific and unique context specifying ourselves. Objects may have the same mass or charge but they don’t contain equal information about their comings and goings, otherwise there would exist things identical to each other in the universe. So we see that time is, in some sense, a property which designates where different things should be, relative to each other. Even more, if we identify time with motion, the motion of things doesn’t occur in time but in space. We could say that time is a property that arranges things in physical space and in our minds by ‘moving’ them here and there in an orderly way.

So the meaning of the extended present is unbiasedly brought forward as an object which occupies space and contains the property of an orderly arrangement of things, thus time. From within the extended present consciousness brings forward events, considers them, and attributes time to them, by properly arranging them in space. But is our consciousness subject to space-time? On the contrary, we could say that consciousness spans our extended present and that it may also choose the topology and the chronology of events. So consciousness is an extended object which attributes space-time to itself, by causally relating events to each other. In a sense, consciousness is space-time. But this realization shouldn’t be considered surprising or arbitrary. The universe doesn’t ‘think’ about space-time, we do. So we live within the context of our consciousness and its extended present, in unison with the extended present of the universe. We use focused attention and methods of observation to select things from an invariable and indifferent cosmic background, which have a certain meaning to us. We point out here and there causal relations between events in the universe, while the universe itself is an event that occurred spontaneously out of nothing. So causality is not a fundamental property of things, but a secondary process of consciousness, which offers the world space, time and meaning.

The extended present is a causal loop



A retrograde loop of two events A and B. Event B predisposes event A, so that A be the cause of B. Causality seems to be temporarily violated, but in fact both events occur, in a sense, simultaneously, so that there is no causal relation between them. It is the loop itself which connects both events.

According to Stanford encyclopedia of philosophy, backward causation, is believed to give rise to paradoxes, that if they are valid they exclude backward causation from being both metaphysically and logically possible. The paradoxes can be divided into two categories: Bootstrap paradoxes, which involve a causal or information loop, and consistency paradoxes. The bootstrap paradoxes arise in cases where you have a causal chain consisting of particular events in which a causes b, b causes c, and c causes a. The problem here is that the occurrence of a, presupposes the occurrence of c; in other words, the cause presupposes its effect. But how can something be required of what itself requires? Indeed this seems paradoxical. Some philosophers therefore think that this makes the idea of causal loops incoherent. Hugh Mellor even believes that “the possibility of causal loops can be excluded a priori, and so therefore can the closed time-like paths entailed by closed time, backward time-travel and all kinds of backward causation.”

The consistency paradoxes arise when you, for instance, try to kill your younger self by a backward causal process, which evidently have to fail. The reason why you must fail is believed to be quite obvious. Your younger self belongs to the past and therefore, since you cannot change the past, you cannot commit retro-suicide. This answer tacitly assumes that resurrection is impossible. You may, of course, kill your younger self in the past without changing the past if you have come alive

again later on. This is not what is paradoxical. What is paradoxical is the fact that you are assumed to be able to kill your younger self in the sense that you are well-equipped to make these kinds of retro-killings, you may even be targeting your younger self, but you must always miss. The same holds, indeed, for all those people who stay alive into the present. You cannot retro-kill somebody yesterday who is alive today. There must be certain constraints which prohibit you from making retro-suicide or retro-killing, and these constraints may be very local, changing from case to case, or they may be universal in nature depending on some physical laws. So, on the one hand, the assumption is that it is physically possible for you to kill somebody in the past; but, on the other hand, it is physically impossible for you to do what is physically possible. This is the paradox.

As far bootstrap paradoxes of backward causality are concerned, the explanation is easy: event A creates B, event B creates C, but event C creates a new event which is not A, but, let's say A'. This is true because space and time have evolved, so there isn't any chance going back in space-time, at the place and time where event A originally took place. The paradox occurs because we regard space-time as point-like, so inevitably we move from point to point in space-time, where each previous point is the past of each next point. But let's consider the whole process in the context of the extended present: Events A, B, C and A' happen somewhere within this extended context of space-time, so they don't have a pre-determined temporal attribute. If we regard A as a past event, A' as a future event, then events B and C will be successive present events. But this would be just a choice. On the other hand, if events A and A' coincide in time, then obviously they are not causally related to each other.

With regard to consistency paradoxes, let's suppose we went back in time to our childhood at a time when our grandfather was still alive. What we do is to create a loop in space-time, which we use to travel back to its past-like limits as youngsters, in order to meet someone, more or less, of the same age (in this case our young grandfather). If this journey is regarded to have taken place outside the reference frame of our present time, then there would be no way to travel back to the past, so in this case there would be no way going back in time to kill our grandfather. But if we assume that past events are included in the framework of the extended present, our grandfather is still alive, in some sense, so we can go 'back in time' and kill him. So what happens now? There may be a news report about two youngsters having quarreled. One of them killed the other, while

the killer died soon afterwards by some unknown causes. The notion of the extended present permits such actions of retrograde death but it raises no paradoxes, because all events happen within the same loop of space-time, so by killing our grandfather we also kill ourselves.

But backward causation is only half the truth. The other half is what we could call ‘forward’ causation. When we observe nature we usually see the effects and not the causes, so we use backward causation in order to imagine what the causes might be, at the second place. On the other hand, when we experiment we bring about the effects in order to retrospectively verify the presupposed, by backward causation, causes. Furthermore, a phenomenon is considered valid when we can reproduce it by experiment, an arbitrary number of times. So backward causation takes us back to undisputable, everlasting ‘truths,’ while forward causation gives us commonly accepted and well- tested ‘results.’ But the necessary condition that an experiment must always be reproducible by repetition brings forward the infinite loop itself, which consists of both backward and forward causation.

This is what the previous image depicts. Events A and B move in ‘opposite’ directions, both in space and time, forming an infinite loop. Equivalently, we may regard that the loop spontaneously creates the two events. It seems that event B travels ‘back’ in time to generate its cause, which is event A. But this is more likely an ‘illusion:’ the two events are more or less simultaneous, while the difference is made at the stage when we attribute cause to the events, either by forward or by backward causation. So, any kind of ‘space-time difference’ is retrospective, as both events at the first stage are conditional. Even if this simultaneity, or ‘equivalence,’ is difficult to be perceived, its existence may easily be proved by the fact that we are always inclined to attribute physical causes, which implies that these causes don’t pre- exist. As far as the ‘*more or less* simultaneous’ term that I used, it expresses exactly the ‘break’ between the two states, one of which is fundamentally space-less and timeless, while the other is full of space- time. So this sort of division has not to do with time but with symmetry.

It seems as if life were running towards us, leaving us with the impression that we instead are heading to the future. So, forward causation could be treated as a ‘retarded’ response of the brain with respect to an ‘advanced’ condition set by consciousness at a ‘higher’ level. According to such

a treatment, backward causation is just forward causation in a ‘negative’ direction. Each time we ‘go back’ to the past, real time runs toward the future. So, either we consider the past or the future, we move forward in time. Consequently, backward causation needs something more in order to offer us a journey in time: We need to build first a condition in the future and then run backwards to the present to make sure the condition is met.

Such an aspect is realized in physics by Wheeler-Feynman absorber theory, which we previously discussed. Why, for example, we don’t we see any advanced waves in nature? Wheeler and Feynman, according to Wikipedia, said that radiation from an isolated accelerated charged particle is equally retarded and advanced, so we can explain why it appears to be fully retarded in terms of the influence distant absorbers make on the source. Feynman had also come up with the idea that the electron could go backwards in time as a possible interpretation of the positron. In fact the positron may be regarded as an advanced, future- like condition, materialized in the form of a ‘retarded’ electron at present. But the truth is that both parts of the electron- positron pair are more or less simultaneous and equally virtual. However, nature seems to prefer the electron against the positron. How may this deep asymmetry be interpreted? Is there a fundamental reason that nature finally chooses one part of the pair against the other?

The trivial explanation about the dominance of matter in the universe in the form of electrons is that at the beginning there were just a few more electrons than positrons, which form anti- matter, so that not all electrons cancelled out after matter- antimatter annihilation processes took place. But the point is that we may not only consist of electrons but also of positrons in equal amounts. It seems more probable that electron- positron pairs are omnipresent, even in the form of ‘photon-loops,’ but for some reason we only ‘see’ electrons, which we consist of, instead of positrons. Positrons seem to be the ‘sacrificial lambs,’ that bring about the ‘fulfilling prophecy,’ in the form of electrons. In other words, the positron and the electron is a pair of a post- condition and a pre-condition respectively, brought forward into the material world. In fact the causal loop which the electron- positron pair forms is a loop not only of ‘annihilation’ but also of creation. It is reminiscent of the eternal struggle of light against darkness. However, both elements coexist in the universe, light and darkness, electrons and positrons, advanced and retarded waves, but, for one

reason or another, we perceive ‘one half of the whole,’ each time. So, fundamentally, what seems to matter is the loop itself.

Up to this point, we may have succeeded in realizing the fallacy of causal division, when we are ‘irrationally’ forced by nature to choose one part against the other. This choice may seem irrational but it is naturally justified: It brings conditions into existence. But this necessary division brought forward by the conflict between forward and backward causation makes us not see the forest for the trees. In our case the ‘forest’ is a causal loop while the ‘trees’ are events, ‘casting the shadow of their conditional pairs.’ For example, the aforementioned events A and B could represent the particle- antiparticle pair, the ‘retarded’ and ‘advanced’ pair of waves or any other pair of ‘complementary’ entities. It seems that B ‘predisposes’ A as its cause so that B establishes itself as the virtual part of an imaginary process, but we had better consider events A and B equivalent. They represent the manifestations of the same causal loop, so that the choice which of them comes first is just a matter of perspective. If this description is identified with the situation taking place at the initial level, then a causal ‘chain- reaction’ between the events may begin at the second level, so that one event is arbitrarily and retrospectively chosen as the cause of the other. Consequently, this choice reduces to randomness. As far as the loop is concerned, it may be considered a ‘bubble’ in time, which splits into two symmetrically manifested events. During this ‘break’ of symmetry, we may say that time doesn’t ‘flow,’ but ‘extends.’ It is a condition that is expressed, not a material process. This is why we say that no information is involved, as this stage. However, both events are non- locally connected to the loop. We may also regard event B as a conditional chicken that laid a real egg, that is event A, containing all the information about the birth of the supposed chicken in the real world. But again this would be a causal interpretation, belonging to the second stage of conscious realization. So, we had better consider both events fundamentally equivalent, that is simultaneous. But this simultaneity is condition- symmetric rather than time- symmetric.

We may regard infinite loops as short- lived and minuscule objects, but they may also be long-lived and macroscopic objects. The universe itself could be such a loop. It was born out of nothing, so that even if we consider ‘God’ or the ‘multi- verse’ as an ultimate cause, finally we are left with the loop itself: we can end the infinite regress only with a spontaneous ‘act of brilliance.’ The universe was not only spontaneously generated, but also expressed its pre- conditions as its future

properties. This is a violation of causality by all means, and in any sense. Still this conclusion seems to be the result of formal reasoning trying to imitate spontaneity. Nevertheless, this sort of ‘locality breaking’ with respect to a spontaneous pair of an infinite loop may be regarded as an act of consciousness. A progressive chain reaction in a set of events which breaches the symmetry and causally relates one event to another constitutes an infinite causal chain of the kind we discussed earlier. Space- time as we know it is the framework of such chains of events lined up in a temporally hierarchical way. This view may lead to a limited perspective of communication with respect to spatially or temporally remote events. However, this communication has already been established by consciousness. Space- time lives in our minds, so that unconscious communication is consciously interpreted as simultaneity. The extended present is basically the ‘space- time’ of unconscious, underlying processes, living in the world of ‘conditionals.’ Physical space- time is the causal recreation of this primordial background map, which consciousness divides into ‘countries,’ recognizes ‘historical facts’ and individualizes ‘experiences.’ So infinite loops are not necessarily minuscule and short- lived objects. On the contrary, they may be gigantic and long- lived objects at the size of a universe. They may also be, on a different scale, unitary and everlasting objects, or ‘truths,’ at the magnitude of consciousness.

Causal loops occur spontaneously in nature. Our mind also exhibits spontaneous behavior, at an unconscious level. The universe itself may have occurred as a causal loop at its initial stages. Infinite causal loops are self- referring and self- repeating impossible objects which may even be reproduced in the laboratory. For example, quantum entanglement has the characteristics of a causal loop. Loops of electron- positron pairs can be experimentally produced too. This sort of entangled pairs may be regarded as the symmetrical constituents of infinite loops. Infinite loops are not point- like objects but extended ones. They enclose space-time but in a primal, undifferentiated form only to be expressed later, at the stage of the ‘realization of expansion.’ They contain ‘future’ and ‘past’ but only in the wider sense of the extended present. The extended present is in fact a causal loop. It ‘blinks time’ and ‘breathes space’. It is the physical ‘airspace’ of consciousness. All information processes can be unfolded, analyzed, altered and restored within it. Space is the ground of physical separation of events while time is what makes events to orderly move to their appropriate places. This causal process of ‘meaningfully’ arranging random information can be identified with consciousness itself. So consciousness has the characteristics

of a causal loop possessing the properties both of spontaneous inspiration and analytical reasoning. It creates a causal division between the past and the future in order to keep the balance with reference to the extended present.

According to Stanford encyclopedia of philosophy, it is believed that closed time-like curves are impossible. However, such curves have already been regarded and described. The earliest example is Van Stockum's 1937 solution of the Einstein field equations, representing an infinitely long cylinder made of rigidly and rapidly rotating dust, causing a closed time-like curve to form around the cylinder. Another example is Gödel's solution of the same equations, which describes a rotating universe able to create closed time-like curves. Both solutions have been dismissed as 'unphysical' because they either include an infinitely long source or a (too fast) rotating universe, respectively. There has even been proposed a 'chronology protection mechanism,' which forbids the creation of closed time-curves in nature. Such a mechanism could be provided, for example, by an event horizon created around the closed time-curve, so that someone travelling back in the past would violate this chronological barrier and therefore he would never be able to return and tell us his story.

No matter what a closed time-like curve might really be or look like, a rotating cylinder, a wormhole, the event horizon of a black hole, or something else, it may not necessarily have the form of a 'circular' object. Instead, we should regard a 'bounded but infinite' mathematical object. Such an object would be geometrically visualized as a closed curve, which could instantaneously connect two 'places' in the universe, at its edges, no more than two 'points of view' of a self-referring argument. In fact consciousness has the properties of a closed time-like curve, constantly travelling to the past or to the future and coming back without any local restriction. Of course this journey of consciousness is imaginary. When we 'visit' the past, we don't get any younger. Neither could we travel to the time of the dinosaurs in order to get ourselves eaten by one of them. Nevertheless, as far as a 'physical' journey in time is concerned, it is considered that a 'time-machine' could be used only from the moment it was built onwards. Consequently a journey in time doesn't mean going 'back to the past.' Instead it has more to do with the generation of a time-like closed loop, consisting of a pair of events, a past-like and a future-like, so that one may travel from one event to the other 'backwards,' within the loop's extended present. If we someday

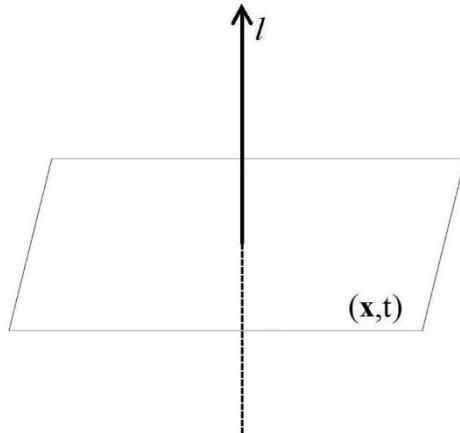
discover a natural time- machine, a wormhole for example, created at the beginning of the universe, we could somehow use it to learn about the whole history of the universe. But again this past- like or future- like journey ‘in time’ would always take place at present, in its extended sense anyway.

In an analogous way, the extended present may be regarded as a closed time-like curve. We can move backwards and forward from a point of reference representing the present, to consider past- like or future- like events always revived at present. So there is no sense referring to the past or the future as events separate from the present time. On the contrary, the present should be considered as an extended event stretching into the past and the future. Consciousness itself may produce loops of future- like and a past- like pairs of events, in a spontaneous act of sustaining the balance at present. Consciousness lives in the present while it reflects on the future and the past. We don’t get younger when we think about our childhood, nor we get older when we think about tomorrow. So time is basically a balance mechanism, a state of orderly arranged things, an unfolding scenario being watched from a point of view in the present.

When we try to remember a dream we saw the previous night, the event we consider is not the same event we dreamed of. This is the difference between unconscious inference and conscious selection. If we had all the time in the world available, then we could just wait to see what the outcome of our considerations would be. But since we can’t last for so long, it is sufficient to discover or produce truths that will last forever. Furthermore, since macroscopic objects, such as universal truths, may not last longer than the universe, we may need to find more fundamental entities, some sort of ‘primordial states.’ These may be called singularities. Such a singularity produced the universe itself. Another one sparks our inspiration. All singularities are infinite causal loops. They are immortal entities living beyond any constraint of locality. They spontaneously express themselves, while the causal relations are established afterwards. And we are able to know this, because consciousness, as a natural process, works the same way. The physical world is not irrelevant to our mental world. Distant stars, for example, are considered in the past, since light needs time to travel the in between distance (which distance is usually enormous). On the other hand, our expectation that we may someday reach the stars propagates out there to the future. So while we contemplate about the future of the distant stars, their past simultaneously reflects upon

our eyes. This miraculous act of universal harmony fills the infinite loop and establishes the balance, one moment after the other, in the framework of the extended present.

### The symmetrical aspect of the extended present



Representation of an extra- dimension: The plane consists of the four-dimensional space-time as we know it. The line  $l$  represents an extra- dimension. An extra- dimensional object, travelling on line  $l$ , will leave a four-dimensional trace on the plane, as it passes through. This trace would be perceived by us as a set of events simultaneously happening in our four- dimensional space-time.

The symmetrical nature of an infinite loop is reflected upon causal division at the stage of conscious realization. The non- local connection between the divided parts is what remains from a holistic object living beyond the sphere of our four- dimensional space- time. The consequences however of this break of symmetry are manifested all over the physical world in the form of premonitions or pre- conditions of imprinted collective memory. Consequently we somehow have an ‘intrinsic experience’ of the cosmic being at a deeper and unconscious level of existence. This proportional relationship between intrinsic reality and perception of expressed reality is necessary so that we keep ourselves ‘fine- tuned’ with the rest of the world. This fine- tuning between the universe and ourselves is expressed at a physical level with the constants of nature, and it is identified with intelligent life itself. Thus the axiomatic ‘truths’ of our system of logic are self- sustained, and are reflected on the physical constants which determine the everlasting power of natural laws. Another name for this principle of analogy between us and the world is the anthropic principle. It simply states that the universe was ‘programmed’ at the beginning to contain the necessary conditions so that intelligent life could evolve at some later stage. The simple proof of

this is that we know it. Of course the anthropic principle is self- referential because, on the other hand, if the universe wasn't able to produce intelligent life, then we wouldn't know it.

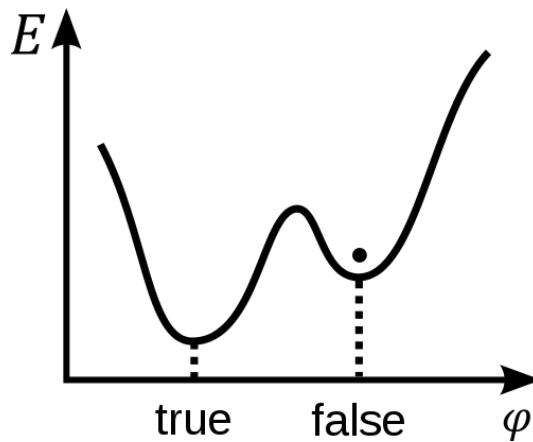
The self- referring aspect of consciousness with respect to its own existence seems inevitable. This sort of an infinite causal loop looks like a self- evident truth, which is thus to be found beyond any process of causation. We could retrospectively say that causation itself leads to this paradox of non- existence, by revealing a deeper level of spontaneous generation. So it seems that events should be more likely treated as preformed conditions, at the moment when rational thinking catches on to them. This spontaneously symmetrical process that goes on at the level of the unconscious seems to work this way: It creates in the present a condition about the future with respect to a precondition about the past. Both the condition and the precondition are necessary for the infinite loop to be formed, and they are produced simultaneously. The arrow of time is then triggered and begins to travel from the past to the future. Unmatched conditions seem to keep on living like ghosts which are coming from the future, until they match with a precondition so that they are both 'canceled out.' Unconfirmed preconditions, on the other hand, gradually fall into a state of 'eternal past,' becoming legends.

This process very much resembles the spontaneous creation of virtual particles in the vacuum, according to quantum mechanics. These particles are produced by vacuum energy, a supposed underlying background energy that permeates the universe. Virtual particles are created out of vacuum fluctuations in particle- antiparticle pairs, which shortly after annihilate each other and disappear. However, some of these don't cancel out and 'jump' into reality. Furthermore, some of them may interact with other particles, before they disappear. Vacuum energy has a number of consequences. For example, as Wikipedia describes, physicists Hendrik Casimir and Dirk Polder predicted the existence of a tiny repulsive force between closely placed metal plates due to resonances in the vacuum energy in the space between them. This is known as the Casimir effect and has since been extensively verified in experiments. It is therefore believed that vacuum energy is real, in the same sense that more familiar conceptual objects such as electrons, magnetic fields, etc., are real. Other predictions are harder to verify. The creation of these virtual particles near the event horizon of a black hole has been hypothesized by physicist Stephen Hawking to be a mechanism for the eventual 'evaporation' of black holes. If one of the pair is pulled into the black

hole then the other particle becomes ‘real’ with the form of energy or mass that is essentially radiated into space.

This is exactly the quantified version in modern physics of a spontaneous infinite causal loop. The part of the pair of particles that comes into existence becomes the ‘confirmed condition,’ while the other part which sinks back into the vacuum or into an event horizon is a ‘sustained precondition.’ The interaction of these causal loops with others expresses the possibility of a chain reaction in the vacuum, where new particles are created. So post- conditions and pre- conditions are created spontaneously and simultaneously all the time.

While spontaneous generation is a basically symmetrical process, the physical separation of the virtual pair so that one of the partners becomes real is described by a process that is called spontaneous symmetry breaking. According to Wikipedia, symmetry breaking in physics describes a phenomenon where small fluctuations acting on a system which is crossing a critical point decide the system’s fate, by determining which branch of a bifurcation is taken. To an outside observer unaware of the fluctuations, the choice will appear arbitrary. This process is called symmetry breaking, because such transitions usually bring the system from a disorderly state into one of two definite states. Symmetry breaking is supposed to play a major role in pattern formation. It explains most simple phases of matter and phase-transitions, like crystals, magnets, and the properties of conventional superconductors. It may also describe the famous Higgs mechanism, by which particles obtain mass. So, single parts of virtual pairs of particles become real through an actual rupture in the symmetry that produces something out of nothing.



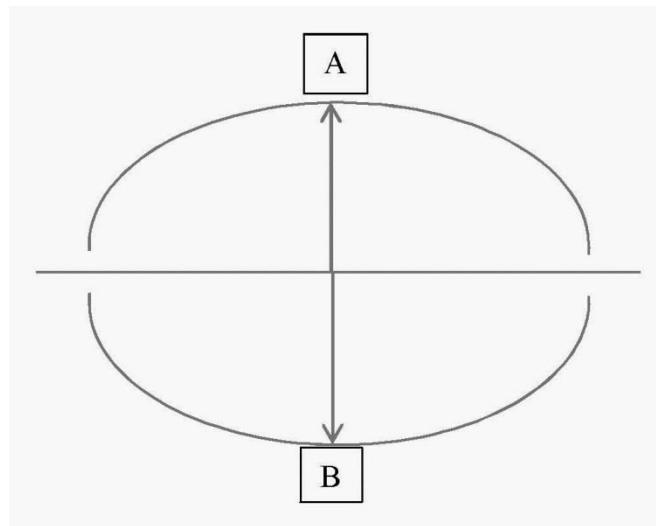
A scalar field  $\varphi$  in a false vacuum. Note that the energy  $E$  is higher than that in the true vacuum or ground state, but there is a barrier preventing the field from classically rolling down to the true vacuum. Therefore, the transition to the true vacuum must be stimulated by the creation of high-energy particles or through quantum-mechanical tunneling.

Is it possible that the universe itself is the outcome of such a process of spontaneous symmetry breaking at a macroscopic scale? Is it the realized or ‘manifested’ part of a virtual pair of universes which spontaneously popped up out of the multiverse? Of course, the universe looks like a gigantic ‘time- machine’ produced by a non- local infinite causal loop, the breach of which we call the Big Bang, through a process of spontaneous symmetry breaking. Someday it may altogether collapse into a vacuum state, where it came from. Metastability in physics describes such a ‘vanishing behavior’ of systems that can exist in long lived states that are less stable than the system’s most stable state. In quantum field theory, a false vacuum is such a metastable sector of space that is unstable due to effects that may tunnel to a lower energy state. This tunneling can be caused by quantum fluctuations or the creation of high-energy particles. Simply put, the false vacuum is a local minimum, but not the lowest energy state, even though it may remain stable for some time. A vacuum metastability event takes places when the system collapses from a state of ‘false’ vacuum to a state of ‘true’ vacuum. The aspect that we are living in a false vacuum is only a possibility, and chaotic inflation theory suggests that the universe may be in either a false vacuum or a true vacuum state. Vacuum decay is the ultimate ecological catastrophe: if a bubble of lower-energy vacuum were nucleated, it would expand, approaching at nearly the speed of light and destroying the Earth instantaneously, without any forewarning. Thus, this vacuum metastability event is a theoretical doomsday event.

So, spontaneous loops may undergo a vacuum metastability event and disintegrate into their ‘true vacuum’ state. The universe itself may be such a loop or bubble of false vacuum that will eventually collapse into the true vacuum. But as far as our discussion is concerned, the vacuum is the source of spontaneous creation, while the breach of the symmetry gives events a chance in the real world. Even everyday events may sometimes assume a ‘metastable character.’ For example, points of view may be found to have been wrong. In such a case, these views undergo a process of change from a state of ‘falsity’ to a state of ‘originality.’

The aspect that consciousness may be able to cause spontaneous symmetry breaking is intriguing. In this case, vacuum energy could be the playground of the unconscious, which would be constantly producing virtual pairs of past- like and future- like events. The individualization of such events, so that consciousness would regard them as parts of its own past or future, would have to do with causal selection. As far as metastability events are concerned, they should occur all the time, as consciousness would pass from its excited states of causal selection to the ground state of unconscious spontaneous symmetry breaking. In this case, consciousness could respectively find all the excitement of spontaneous creativity, as well as its deepest level of undistracted concentration and balance, instead of an unstable situation of events that could bring the end of the world.

### Further extensions and implications



The extended present depicted as an infinite causal loop. The spontaneous events A and B are symmetrically produced. The horizontal line forms the surface of an event horizon. At this surface all events may be holographically represented.

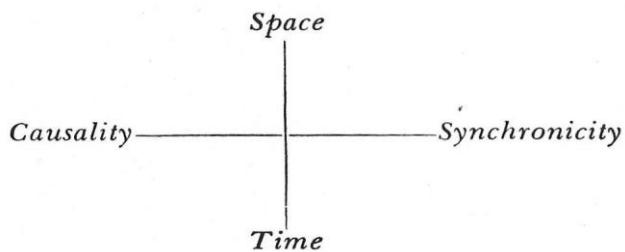
A fundamental question can be raised here. Why nature is sometimes so deceitful? Or is it more likely that we somehow are used to deceive ourselves? There seems to be thus an inherent ‘bilingualism’ or ambivalence both in nature and in the way we see things and act. This basically dualistic property of the world, which can be found simultaneously ‘outside’ and ‘inside,’ is reflected on spontaneous symmetry breaking processes that take place at a fundamental level. Virtual pairs of particles are produced out of nowhere, representing infinite causal loops forming in the vacuum. The universe itself could be such a loop, existing in an infinite number of dimensions. And then, out of the blue, an equally spontaneous process tears apart the symmetry in order to divide the loop’s virtual pair into a ‘real’ part and an ‘imaginary’ one. But even if this process seems to be magical, it is not unfamiliar with respect to the way our consciousness works. Creativity, ingenuity and inspiration, for example, are some of its common properties, which exhibit all the basic aspects of spontaneous generation.

This process of spontaneous rupture of symmetry is depicted in the previous diagram. A loop is created in the substratum. Event A comes into reality while event B is reflected back into the vacuum. We may identify this process with a virtual pair of particles or more generally with two events A and B which acquire a future- like and a past- like characteristic, respectively. The line or surface horizontally dividing the loop in the middle represents an event horizon. In this broader sense, the whole event comprises a singularity.

The concept implied in the previous description is a good example of the holographic principle. In this case, the event horizon identifies the holographic surface, which contains all the information about the event. What is extraordinary in such a description is that the holographic surface of the event horizon could be all that exists. Events A and B are then just reflections, or holographic projections, of a ‘real’ and an ‘imaginary’ object, produced symmetrically to the surface. The holographic principle is in fact a projection operation from a volume to a surface. But what if we made a step further to regard a projection of a point to infinity, or vice versa? In such a case, it would be a one- to- infinity correspondence. We could visualize such a process with a light-cone,

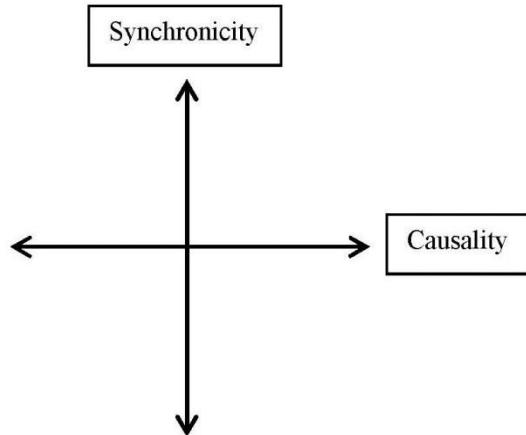
like the one we previously encountered. If we somehow inverted the procedure, we could make a backward projection of the cone to a single point at its apex. Such an idea isn't unjustified at all: Each point of a holographic film contains the information about the whole picture. Each of our cells contains the information about the whole of the body. Each grain of sand may contain the information about the whole of the universe.

We discussed before the holistic aspect of the world. Here we should regard a different sort of connection between things. Events not only affect other objects, but also have a psychological effect on living beings. On the other hand, consciousness participates in the physical processes in a correlative and complementary way. The idea that physical events may be connected with 'psychic' states of the individual was put forward by psychiatrist Carl Jung. According to him, this kind of connection is an acausal one, involving primordial patterns, called archetypes, and an eternal memory of mankind, called the collective unconscious. According to this theory, which is called synchronicity, under certain conditions, physical and psychic phenomena may take place as 'meaningful coincidences.' This sort of connection happens spontaneously, while the events may occur either simultaneously or at different times. In the second case, a present psychic state may be connected with a future physical event which will be realized in due time.



In an essay that Jung wrote together with physicist Wolfgang Pauli, the notion of synchronicity is depicted in contrast to causality, as is shown in the previous figure. As Jung put it in his own words: "Here synchronicity is to the three other principles as the one-dimensionality of time is to the three-dimensionality of space, or as the recalcitrant 'Fourth' in the Timaeus, which, Plato says, can only be added 'by force' to the other three. Just as the introduction of time as the fourth dimension in modern physics postulates an irrepresentable space-time continuum, so the idea of synchronicity with its inherent quality of meaning produces a picture of the world so

irrepresentable as to be completely baffling. The advantage, however, of adding this concept is that it makes possible a view which includes the psychoid factor in our description and knowledge of nature- that is, an a priori meaning or ‘equivalence.’”



With respect to this equivalence or symmetry, we could also represent synchronicity, which, in a specific context, has the characteristic of simultaneity, in a space- less and time- less diagram, with synchronicity on the vertical axis, and causality on the horizontal one. In this case, causality could define an event horizon regularly ‘violated’ by synchronicity. Furthermore, in such a diagram synchronicity could be identified with time itself, as a parameter of order in a wider context. This context can be provided in relation to the notion of the extended present. If the present is regarded as a point then a coincidence of a present event with a future one seems absurd and is incomprehensible. But in the framework of the extended present both events happen here and now, while the future- like event is suspended until it is fulfilled. This view may also represent an extended notion of simultaneity because events that happen together may span different times. But if they are connected to an infinite causal loop, then the odds are that this spontaneous connection will be causally expressed in due time.

This may sound like some sort of ‘fate,’ or like a new form of relentless determinism. But in fact this point of view is no more deterministic than spontaneity itself: A spontaneous event will happen sooner or later, even though we don’t know exactly when and where. We also don’t know why. However, we have seen in this discussion that it will take place within the wider framework of the extended present. We have also learned something about how it is happening: in the form of

infinite causal loops. Furthermore, we may also find out why it happened in due time, when the spontaneous event will reveal its nature through the process of causal correlation. So we may also attribute to the events a meaning. While we really are events living in the extended present, our consciousness is an event itself, connected to all others, ‘confirming’ or ‘rejecting’ them. So we have the power and the means not only to form space- time with our minds but also to designate the cause of things. Not only are we ‘strange loops,’ exhibiting the same talent of instantaneity as nature does, but also we are ‘time-machines,’ having the capability to set things in order with respect to space and time, thus also determining their temporal properties. We are creatures that consider our past while we regard the future. We constantly redefine pre- established assumptions while we anticipate future-like conditions to be confirmed or not. So that, within the framework of the extended present, future actions justify our past.

## NOTE

When I first conceived the notion of the extended present, I was unaware of the work of Edmund Husserl on the ‘phenomenology of temporality,’ where the same notion is expressed. Husserl uses the notions of ‘retention’ and ‘protention’ as key aspects of his theory. According to his view, as described in Wikipedia, our experience of the world is not of a series of unconnected moments. It would be impossible to have an experience of the world if we did not have a sense of temporality. That our perception brings an impression to our minds depends upon retention and protention. Retention is the process whereby a phase of a perceptual act is retained in our consciousness. It is a presentation of that which is no longer before us and is distinct from immediate experience. A simple example might be that of watching a ball being thrown. We retain where the ball was in our minds to understand the momentum of the ball as we perceive it in the immediate present. Retention is not a representation or memory but a presentation of a temporally extended present. That is, a present that extends beyond the few short milliseconds that are registered in a moment of sense perception. Protention is our perception of the next moment. The moment that has yet to be perceived. Again, using the example of a ball, our focus shifts along the expected path the ball will take. According to Husserl, perception has three temporal aspects, retention, the immediate present and protention and a flow through which each moment of protention becomes the retention of the next.

Maurice Merleau-Ponty analyzes the temporal phenomenology of perception as follows:

“Husserl uses the terms protentions and retentions for the intentionalities which anchor me to an environment. They do not run from a central I, but from my perceptual field itself, so to speak, which draws along in its wake its own horizon of retentions, and bites into the future with its protentions. I do not pass through a series of instances of now, the images of which I preserve and which, placed end to end, make a line. With the arrival of every moment, its predecessor undergoes a change: I still have it in hand and it is still there, but already it is sinking away below the level of presents; in order to retain it, I need to reach through a thin layer of time. It is still the preceding moment, and I have the power to rejoin it as it was just now; I am not cut off from it, but still it would not belong to the past unless something had altered, unless it were beginning to outline itself

against, or project itself upon, my present, whereas a moment ago it was my present. When a third moment arrives, the second undergoes a new modification; from being a retention it becomes the retention of a retention, and the layer of time between it and me thickens.”

This is exactly the meaning of our discussion. Events do not form a ‘causal chain of points’ in space-time, connected to each other in a linear and non- flexible way. Instead, they are extended objects spanning space- time. At a first stage, pairs of events are spontaneously created as past- like and future- like symmetrical conditions. Temporality is then involved, at the second stage, arranging events in a causal process of future- past division. Thus these conditional pairs of events consist of ‘retained’ and ‘proteinized’ partners, which will either be expressed and realized, or the infinite causal loop associated with them will disintegrate and return to the vacuum.

Still, the parts of this spontaneous pair of events are non- locally connected to each other, so that any causal succession of events that consciousness recognizes is arbitrary, though, in a sense, necessary. Furthermore, post- conditions and pre- conditions, which correspond to Husserl’s protention and retention respectively, are not just perceptual representations of ‘real’ events, but instead they represent true conditions realized by consciousness. So what is fundamental in the whole process is not time, which is just a form of order taking place at the second place and retrospectively, but the non- local collapse of the infinite loop and the instantaneous distribution of the events.

Consciousness is certainly not an idle and stationary object at the ‘center’ of its ego- universe, separated from all other events that it regards. On the contrary, it participates and forms space- time by arranging things. It even gives cause and meaning to things. But at the same time, consciousness is not just a process, the path each time chosen from an infinite number of possible routes in the distribution of events. It possesses the holistic property of its non- local and symmetrical deepest nature. It also contains the holographic information of events in each part of its space- time. So, we may say that consciousness is the awareness of the distribution of events itself, having the ability both of causally considering the parts, at present, and spontaneously imagining the totality, in its extended present.



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